A DEMONSTRATION OF NEW TECHNIQUES FOR LOW-COST SMALL HOME CONSTRUCTION

1954

Housing Research paper 29

HOUSING AND HOME FINANCE AGENCY
Office of the Administrator
Division of Housing Research

Housing Research Paper No. 29

April 1954

For sale by the Superintendent of Documents, U. S. Government Printing Office,

Washington 25, D. C. . . . Price 60 cents

A DEMONSTRATION OF NEW TECHNIQUES FOR LOW-COST SMALL HOME CONSTRUCTION

by

Raymon H. Harrell

Research Associate

and

James T. Lendrum

Director

Small Homes Council

University of Illinois

HOUSING AND HOME FINANCE AGENCY · Albert M. Cole, Administrator

Office of the Administrator

DIVISION OF HOUSING RESEARCH · Joseph H. Orendorff, Director

Washington 25, D. C.

Foreword

A small group of home builders, less than one percent of the total, built one-third of all dwelling units started by residential building firms in 1949.

Large-scale operations have permitted members of this group to experiment with new methods of design and production and to develop techniques which have demonstrated cost and quality benefits over older traditional methods.

What about the other 99 percent of the builders? Many, by necessity, had to confine their operations to small volume production and were forced to operate with a minimum of management procedures and controls in order to keep overhead costs low. They were not in a position to experiment even though the new ideas and techniques developed and used by the large-scale organizations had been publicized and were available for use by the smaller builders. Not available generally were the step-by-step procedures followed in the newer methods nor specific data on the amounts of materials used and labor expended which would permit the smaller builder to make meaningful comparisons with his own operations. To obtain these data, it would be necessary to actually try the newer methods in dwelling construction. In many cases, the smaller builder could not afford the risks involved in trying to find out whether he could benefit by adapting the newer techniques to his smaller operations

In an attempt to overcome this difficulty, the Housing and Home Finance Agency entered into a contract with the University of Illinois to undertake a demonstration project under the direction of its Small Homes Council. The primary purpose of the project was to make available in useful form for the smaller builders a description of the newer methods, together with step-by-step procedures for accomplishing them, and actual job records of materials and labor requirements.

Equipped with these data, the builder would be able to compare his current operations with the newer methods in detail and be in a position to identify those techniques which showed promise of benefits for him without the possible costly procedure of actual building. Having identified potential cost saving procedures, he would be provided with sufficient information to instruct his workmen and organize the job for maximum efficiency on the basis of the descriptive procedures provided.

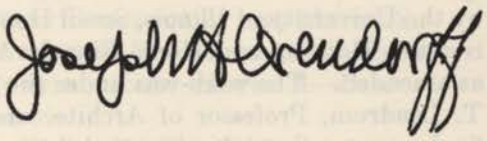
During the course of the research, two demonstration houses were designed by the Small Homes Council on the basis of an analysis of modern requirements and facilities available for convenient and comfortable family life and an analysis of new structural details and assembly methods which have been developed to meet the requirements of modern production methods. Considerable material relating to house design, site planning, and new construction methods was assembled and analyzed as a basis for determining the houses to be used in the demonstration. A digest of this byproduct material is included in Appendices A and B because of its general interest and value. In addition, methods were developed which permit control of construction operations for greatest efficiency and assured quality. The Small Homes Council also was responsible for the keeping of material quantity and labor time records during the course of construction.

The two houses were built by Harrell and Lendrum, builders in the Champaign-Urbana, Illinois, area, at their own expense, which was recouped through sale, after completion. The builders and workmen cooperated fully in following the pre-planned techniques of construction.

The general analysis of the new techniques set forth in the report provides general guides which should be helpful in the planning and construction of solid masonry or masonry veneer dwellings even though the demonstration houses had exterior walls of frame.

Finally, it must be stressed that the purpose of the demonstration was not the development of a standardized house of lowest cost, but the development and demonstration of principles of planning and assembly techniques which may be utilized in the design and construction of any dwelling structure. Examples of nonstandardized houses which employ these principles in a variety of ways are shown in the Appendix which also contains a layout illustrating site planning practices.

LIMITATIONS.—The demonstration houses were developed for use requirements in central Illinois and, consequently, the end product of design practices would not be suitable everywhere. For example, in areas where people are refugees from heat rather than cold for most of the year, a different set of design requirements would have to be met. However, the principles of design and construction analysis will have quite general application.



JOSEPH H. ORENDORFF,
Director of Housing Research.

Acknowledgments

The research and studies forming the basis for this report (Research Project 1–T–119) were performed by the University of Illinois, Small Homes Council, pursuant to a contract with the Office of the Administrator, Housing and Home Finance Agency, authorized under Title III of the Housing Act of 1948, as amended. The work was under the direction of Raymon H. Harrell, Research Associate, and James T. Lendrum, Professor of Architecture and Director, Small Homes Council, who also prepared the final report. Special acknowledgement is due to the following members of the Small Homes Council staff: R. A. Jones, A. I. A., architectural consultant; Elizabeth M. Ranney, architect-designer; Jerome W. Schwaiger, research assistant; and John Solo Rio and Richard Mayne, time-study assistants. George A. Speer, A. I. A., Chief, Design and Development Section, Division of Housing Research, was the staff technician for the Agency during the course of the research activity.

The report, prepared by the Small Homes Council, describes the entire operation in detail, tabulates time and material requirements, and summarizes the findings. Expressions of opinion in the report concerning uses of material and the relative merits of various planning and construction techniques are, of course, those of the Small Homes Council.

Copies of a 16-millimeter motion picture film which show each step in the construction process, may be obtained, upon request, on a loan basis, from the Office of the Administrator, Housing and Home Finance Agency, Washington 25, D. C.

Contents

LIST OF TABLES

Abstract

This study was undertaken as a field demonstration of those construction techniques, design features, and structural details which have been proven to materially reduce the cost or increase the quality of small house construction. As a part of the study, a program of objectives was written, and a low-cost house, of approximately 1000 square feet of floor area (30′ by 34′) was designed. Working drawings were made for the basic house and for one alternate orientation. These combined the usual description of size, shape, and location of material with specifications of quality and a step-by-step sequence description of the assembly process.

Variations in the placing of the house on the lot for different orientations were studied, and a site plan was made for a small development showing how these variations could be used by a builder to produce an interesting street scene.

Two houses were built in Champaign-Urbana, and a detailed time and material study was made, as well as a 16 mm. motion picture covering the construction assembly procedures. Two additional houses were built in a neighboring state by another contractor, and additional time records were made during their construction.

Recommended practices which were shown to have a definite cost reduction effect include modular design, simplified foundation details, precutting of materials, preassembly in jigs, tip-up wall construction, roof trusses and pre-assembled gable ends, simplified plumbing practices, simplified trim, and the extensive use of small power tools.

All of the practices which were used were selected to take advantage of the control of assembly techniques possible with modular sized materials. Material quality was controlled, and the lowest in-place cost was secured by balancing material cost against labor time.

The techniques used were also limited to those which could be adopted by a small builder or would be equally successful when used by the larger operator.

FIGURE 1.—HOUSE A—*Constructed on a lot 70 feet by 132 feet, located on the north side of an east-west street. The indoor-outdoor living area is on the south or street side of the house. This house was constructed as the first house in the project.*

FIGURE 2.—HOUSE B—*Constructed on a lot 70 feet by 132 feet, located on the south side of a northeast-southwest street. The indoor-outdoor living area is on the south or the rear of the lot. This house was constructed as the second house in the project.*

PART I

Scope of Project

Two houses of identical design, modified for specific site conditions, were erected under preplanned conditions, including material and time records keeping during construction, as a means of demonstrating the practicality of new planning and construction techniques for the small volume builder.

Design Development

Prior to the design of the houses and based on an analysis of the ways in which social, economic, and technical changes, during the past two to three decades, have influenced dwelling requirements, a list of design objectives was developed as a standard against which various preliminary design schemes could be compared and evaluated.[1]

These objectives were divided into two categories: (a) those considered mandatory in order to carry out fully the intent of the research project, and (b) those which constituted desirable features but were considered to be optional.

Mandatory objectives:

1. The house should be planned on a modular basis throughout.

2. The plan should be a simple rectangle, approaching as nearly as possible a square, both for reasons of economy and for easy placement on the site.

3. The house should be adaptable to open-room construction, and to preassembly and tip-up procedures.

4. The plan should be adaptable to the use of a perimeter forced warm air heating system, with a centrally located heater.

5. Circulation path area should not exceed 15 percent of the total floor area, and should not pass through activity areas.

6. Ample storage space should be provided throughout the house.

7. Provision should be made for a fully enclosed garage with storage space for bulky articles.

8. The plan should be adaptable to solar orientation, no matter which direction the lot should face.

Desirable objectives:

1. Sleeping and storage accommodations in the three bedrooms should be adequate for five people.

2. An eating space should be provided in the kitchen.

3. Laundry equipment should be separated from the cooking and eating spaces.

4. A children's indoor play space should be provided.

5. A direct circulation path should be provided between the kitchen and bathroom.

6. All areas should be planned for maximum flexibility of use.

7. An atmosphere of interior spaciousness should be achieved.

8. Rooms should be planned for varying furniture arrangements.

During the design stage, planning, structural system and materials, and methods of assembly were studied in an interrelated process to achieve a consistent structure, with a nicely adjusted balance between living amenities and construction costs. Several preliminary schemes were designed and, tested by the above standard, modifications were made until the objectives were judged to have been met in the final scheme.[2]

Drafting Room Studies

After the final design had been chosen, items needed by the contractor to carry out the operations as dictated by the house design, were prepared. Complete how-to-do-it descriptions were made of each component. These were studied

[1] The basis for dwelling requirements and design objectives are included in Appendix A, "Preparatory Investigations for Dwelling Design."

[2] See Appendix B, "Description of Plan for Demonstration Houses."

and compared with previous data and methods that had been used by the Small Homes Council and others, and a decision was reached as to the most economical and efficient means of carrying out a particular operation.

In order to anticipate construction problems and possible mistakes and to reduce the number of oral instructions or changes necessary during supervision, a revised concept of working drawings was found desirable. In addition to the usual plan, elevations and typical wall section, there were included a series of drawings recording wallboard layouts; window and door details; closet details and construction procedures, roof construction; foundation construction; heating, plumbing and wiring layouts, and the location of every framing member. In addition, short, concise specifications and step-by-step assembly instructions were included, where deemed helpful, on working drawing sheets. Examples of assembly details are included in a later section, "Procedures and Materials and Labor Time Records During Construction." Shown below are sketch plans and elevations.

Material Lists—Cutting and Ordering Schedules

After the drawings were completed, a material list was prepared as a basis for the cutting and ordering schedules. The materials needed were listed by components—the major parts which make up a completed house. The contractor confined his own construction activity mainly to carpentry, and subcontracted much of the other work. It was desirable to formulate a schedule for each of the subcontractors. This permitted

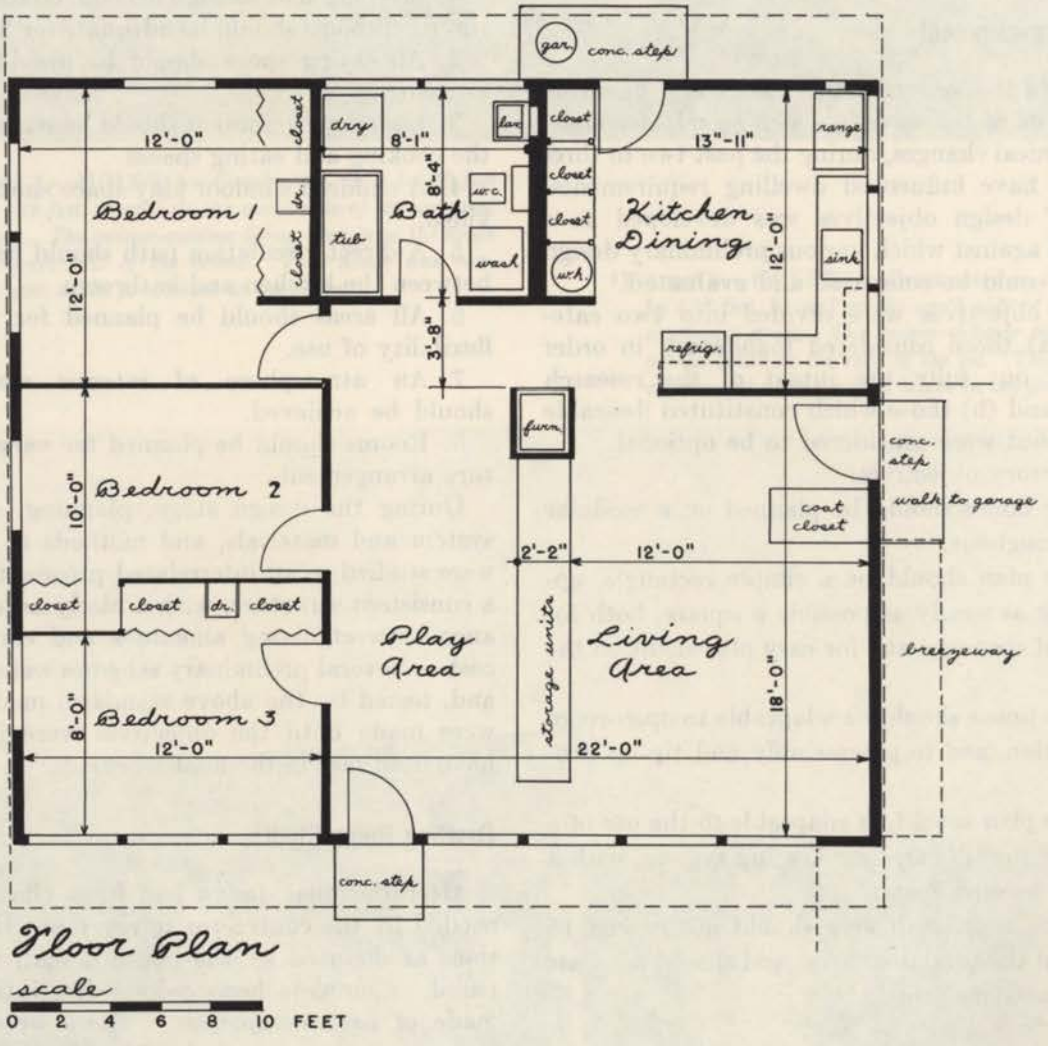
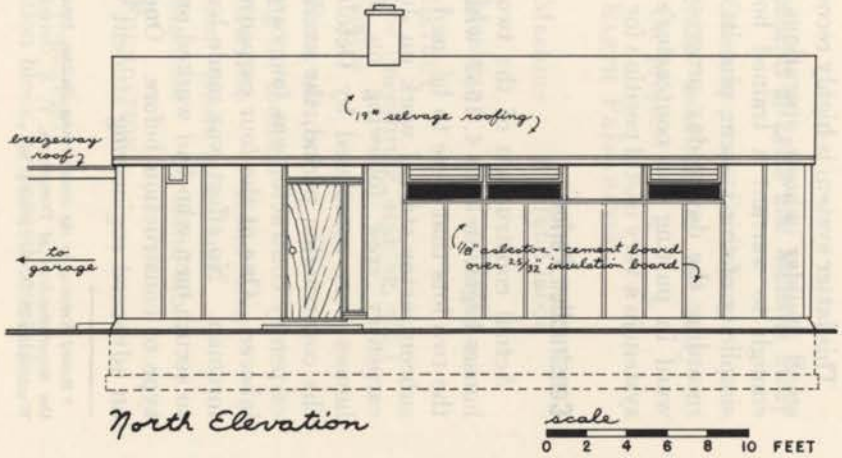
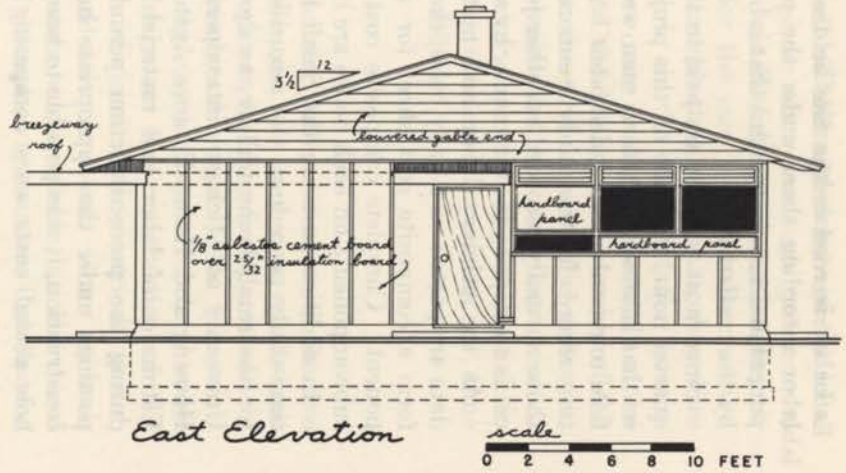


FIGURE 3.—*Plan of demonstration house.*





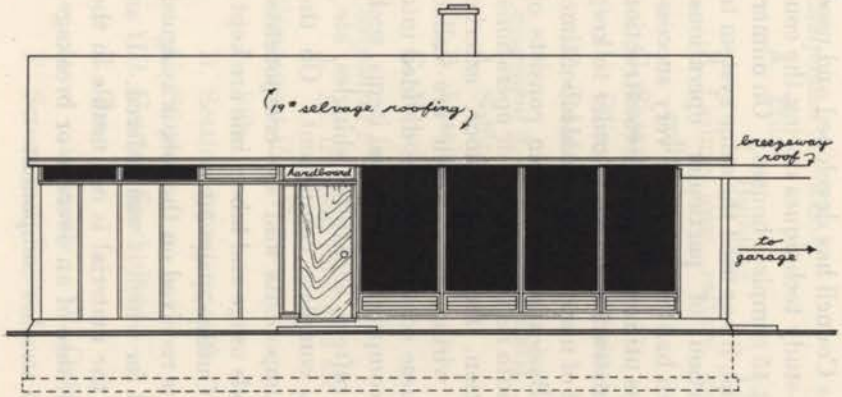


FIGURE 4.—*Demonstration house—north and south elevations.*

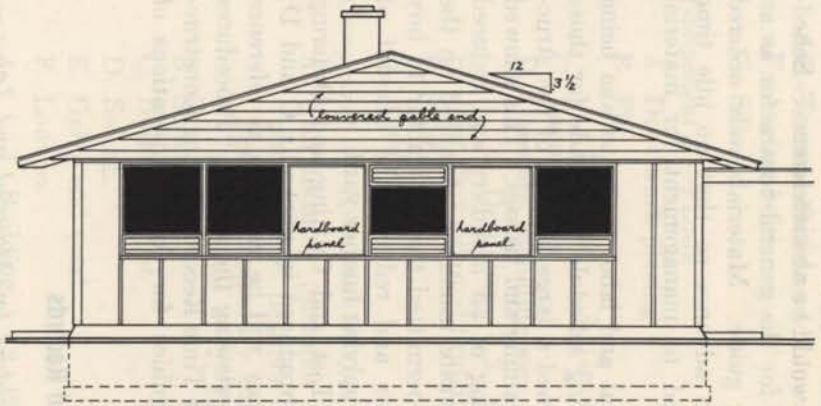


FIGURE 5.—*Demonstration house—east and west elevations.*

the subcontractors to perform their work at a time when there would be no interference. Scheduling also acted for the general contractor as an overall planning guide. Materials were ordered and delivered in advance so that no idle time could be charged to management for material delays.

As the material and labor estimate was being prepared, a cutting schedule was made for those items which formed a large portion of the structure—the wall framing and trusses. This allowed economical cutting of all members and reduced the amount of waste usually experienced on the site. This also permitted the contractor to buy in exact amounts and reduced the amount of returns to the supplying lumber yard.

The Material List and Cutting and Ordering Schedules are reproduced in appendix C and D, respectively. They will be valuable as reference material when reviewing the section "Procedures and Material and Time Records During Construction", and as guides for future operations of builders.

Job Operations and Records

Recording Procedure for Material and Labor.—The Small Homes Council has developed and used a system of time-study techniques during the construction of about 45 complete houses. On numerous other occasions, it has used the same system to study some portion of particular operations. This system which had proven to be very successful in the past, was utilized during the construction of the two demonstration houses in order to keep a complete record of material usage and labor time.

Components.—Basically the system consists of dividing a house into its major parts or operations, such as excavation, foundation, floor, exterior walls, windows, wiring, etc., which are called components. These components are divided into sub-components comprising individual items, such as ceiling joists, rafters, sheathing, shingles, etc., that make up a complete component. On the basis of these components and sub-components, records of materials usage and labor time are kept. (See Component Outline, page 5.)

Material, as it is received on the job, is assigned to the component for which it was ordered. If an error occurs and the material is not usable in the original intent because of an overage or breakage, it is reassigned to another component.

Labor is recorded in the field on the primary labor recording sheet under the particular component and sub-component that is being performed by the craftsman.

Since most payrolls are paid to the nearest one-quarter hour, the time on this project is recorded in that manner. Trained men were used in the field to record all expended labor. As a result, the time records for this study are more accurate than those normally recorded on other jobs where time cards are kept by the foreman or by each individual.

As the primary labor and material-recording data are posted on a daily basis, they combined to form a composite cost sheet for each sub-component. Complete composite cost sheets for all subcomponents on each house are included.

In addition to using the Small Homes Council time-study procedure, the record-keeping system for the small home builder, as developed by the University of Michigan in cooperation with the Housing and Home Finance Agency,[3] was used. Estimates of labor and material were recorded during the preconstruction period. With daily postings under the appropriate headings during construction, it was possible to know immediately how actual costs were comparing with the estimates.

This latter system is highly recommended to the small builder whose operations are not large enough to warrant a trained bookkeeper. The simplicity of this system, plus its completeness in recording the day-to-day progress, is a step forward in putting the contractor's record-keeping system in a very useful position for ready reference.

Construction Period

Actual construction of the two demonstration houses began on June 4, 1952, with the clearing of the two lots that were to be used. The masonry subcontractor started work on June 9, with the carpentry crew following on June 24. Both houses were completed by October 10. During the construction period, the average crew of the carpentry contractor was four carpenters and one laborer. One of the four carpenters acted as the foreman. No effort was made by the contractor to secure men who had worked on this particular type of construction before. One carpenter was an advanced engineering student working for the

[3] *Record Keeping for the Small Home Builder*, January 1952. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.25.

summer months. All were members of the local union.

The weather was ideal during the entire project. No lost time for the men occurred due to rain. On the rare occasions that it did rain, they were diverted to work on the inside of the houses.

Excessive heat came during the assembly of the wall sections and the cutting and assembly of the roof trusses on the first house. The reflection from the concrete slab and the intense heat resulted in one man being overcome by the heat. No other incidents or accidents caused any lost time for the crew members.

The Site

The site chosen for the construction of the two demonstration houses was in a new subdivision that had been open to building for approximately two years. This location was chosen because it was outside of the city limits, and no local codes affected the design or the construction of the house. The subdivision had electrical power, water mains, and a storm sewer. Since no sanitary sewage system was available, an individual septic tank-soil absorption system was installed for each house.

Outline for Components of Labor and Material Study

Component 0.—Construction Buildings

(All temporary construction necessary to complete the project)

Component 1.—Earth Preparation

A. Scrape
   1. Machine 2. Hand labor
B. Fill
   1. Machine 2. Hand labor

Component 2.—Layout

A. Total time (measuring, staking, etc.)
B. Batter boards

Component 3.—Excavation

A. Trenching for footings
   1. Machine 2. Hand labor
B. Excavation—entire house area
   1. Machine 2. Hand labor

Component 4.—Foundation

A. Forms
B. Footing (concrete)
C. Foundation block, or poured concrete
D. Insulation
E. Termite shield
F. Anchor bolts
G. Sills

Component 5.—Floor

A. Duct work placing
B. Fill
   1. Earth 2. Gravel
C. Vapor barrier
D. Concrete, including wire mesh
   1. Dumping 2. Finishing
E. Joist, box sill, and bridging
F. Subfloor
G. Finish floor

Component 6.—Exterior Walls

A. Wall framing (includes top and bottom plate, studs, headers, blocking, let-in-bracing, temporary bracing)
   1. Building 2. Erection
B. Sheathing
C. Building paper
D. Siding
E. Gable end total
F. Louvers
   1. Building 2. Placing

Component 7.—Roof

A. Truss
   1. Building 2. Placing
B. Ceiling joist, rafters, ridge boards, and collar beams
C. Sheathing
D. Shingles (including starter strips)
E. Roof intersection

Component 8.—Exterior Trim

A. Soffit
B. Fascia
C. Rake and frieze

Component 9.—Partitions

A. All framing (includes all openings)

Component 10.—Windows

A. Sills
B. Setting operating sash
C. Stops
D. Setting fixed glass
E. Trim
   1. Inside 2. Outside
F. Screen installation

Component 11.—WIRING

A. Service and fuse panel
B. Wall outlets and switch boxes
C. Ceiling outlets
D. Wiring—roughing-in
E. Installing and connecting duplex outlets, fixtures, and switches
F. Special

Component 12.—INSULATION

A. Ceiling
B. Side walls

Component 13.—WALLBOARD

A. Back-up
B. Ceiling
C. Side walls
D. Partitions
E. Taping
F. Trim
G. Lath
H. Plastering
   1. Brown coat 2. Finish coat

Component 14.—DOORS

A. Jamb
B. Trim
C. Hanging (hinges)
D. Hardware (locksets)

Component 15.—SEPTIC TANKS

A. Complete installation
   1. Tank and distribution box
   2. Field

Component 16.—CABINETS

A. Kitchen
   1. Base 2. Wall
B. Utility
C. Bath

Component 17.—CLOSET WALL UNITS

A. Framework (includes shelves, closet pole, hangers, and trim)
B. Doors
   1. Making 2. Installation
C. Free-standing units

Component 18.—PAINTING

A. Siding
B. Windows (exterior)
C. Trim (exterior)
D. Walls, ceiling, interior partitions
E. Doors
F. Windows and trim (interior)
G. Kitchen cabinets
H. Garage
I. Louvers

Component 19.—FLUE (PREFABRICATED)

A. Total time for installing flue

Component 20.—PLUMBING

A. All under floor work and plumbing wall
   1. Drainage pipes 2. Water supply pipes
B. Fixtures—installation

Component 21.—HEATING

A. Total time for installing furnace, oil tank, fuel lines, fuel pump, etc.
B. Time to install aboveground duct work, including floor and cold air registers

Component 22.—GARAGES

A. Floor
B. Walls
C. Roof (including ceiling joist, built-up roof, trim for roof)
D. Doors and Windows

Component 23.—WALKS AND DRIVES

A. Walks
B. Drives
C. Stoops
D. Porch slabs
E. Fence

Component 24.—ROUGH GRADING

A. Rough
B. Finish—including seeding
C. Planting
D. Gravel strip

Component 25.—MISCELLANEOUS HARDWARE

A. Miscellaneous hardware

Component 26.—BATH TILE

A. Bath tile

Component 27.—STORM WINDOWS

Component 30.—MISCELLANEOUS

PART II

Cost Summary

The Cost Summary, prepared upon completion of the work on the demonstration houses, provides a convenient working guide for builders to compare the costs of their current production with those achieved on the demonstration houses.

Where costs of components for the demonstration houses are shown to be lower than those the builder is now achieving, it should serve as an indicator for a more careful examination of the individual component cost sheets to determine if the difference is in materials used or labor expended, or both.

If both labor and material costs are lower for the demonstration houses, the builder should examine the design and assembly methods used to achieve the lower costs and give consideration to adapting them into his future operations.

This Cost Summary is probably the logical starting point for an analysis of this report. It can quickly show whether the newer techniques have demonstrated any benefits, from a cost savings point of view, for the individual builder.

However, the analysis should not stop here. The principles on which the houses were designed and on which structural details and assembly methods were developed, as well as the managerial aids for the control of job operations, are certain to be useful aids in differing degrees to most small volume builders.

TABLE 1.—*Cost summary*

Component		House A			House B		
		Labor	Material	Total	Labor	Material	Total
1/O	Construction building	$24.00		$24.00	$4.63	$2.85	$7.48
1/OC	Construction building—Toilets					.80	.80
1A1	Earth preparation	22.00		22.00	22.00		22.00
2A	Layout—Total time	18.75		18.75	22.76		22.76
2B	Layout—Batter boards	12.00		12.00	23.41	7.24	30.65
3A2	Excavation—Hand labor	53.65		53.65	62.90		62.90
4A	Foundation—Forms	8.13		8.13	5.55		5.55
4B	Foundation—Footing	12.21	$68.99	81.20	10.18	63.65	73.83
4C	Foundation—Block or concrete	167.28	123.61	290.89	283.27	138.07	421.34
4D	Foundation—Insulation	6.48	60.48	66.96		52.92	52.92
4E	Foundation—Termite shield	3.27	22.50	25.77	3.65	26.10	29.75
4F	Foundation—Anchor bolts		3.93	3.93		3.00	3.00
5A	Floor—Duct work placing	45.25	132.71	177.96	86.32	143.88	230.20
5B2	Gravel	90.75	64.00	154.75	66.06	109.69	175.75
5C	Vapor barrier	7.86	24.00	31.86	5.55	24.00	29.55
5D1	Concrete—Dumping	34.58	236.38	270.96	55.34	262.36	317.70
5D2	Concrete—Finishing	87.11		87.11	38.38		38.38
5G	Floor—Finish	77.89	144.68	222.57	87.60	140.70	228.30
6A1	Wall Framing—Building	43.70	177.09	220.79	61.40	169.85	231.25
6A2	Wall Framing—Erection	65.29		65.29	71.08		71.08
6B	Sheathing	16.20	76.80	93.00	17.35	80.64	97.99
6D	Siding	84.29	110.26	194.55	93.24	126.83	220.07
6E	Gable end	99.74	126.05	225.79	35.58	131.42	167.00
6F1	Louvers—Building	179.57	190.74	370.31	158.60	122.32	280.92
6F2	Louvers—Placing	58.35		58.35	24.38		24.38
7A1	Truss—Building	87.19	209.35	296.54	81.55	245.64	327.19
7A2	Truss—Placing	41.77		41.77	27.29		27.29
7C	Sheathing	76.09	212.90	288.99	58.56	224.14	282.70
7D	Shingles	119.48	161.65	281.13	114.86	154.80	269.66
8A	Soffit	24.68	41.60	66.28	36.25	45.24	81.49
8B	Fascia	7.50	12.24	19.74	10.00	13.26	23.26

TABLE 1.—*Cost summary*—Continued

Component	House A			House B		
	Labor	Material	Total	Labor	Material	Total
8C Rake	$8.75	$20.76	$29.45		$6.29	$6.29
9A All framing (partitions)	82.63	64.10	146.73	$62.66	82.59	145.25
10A Windows—Sills	22.14	9.28	31.42	22.38	1.44	23.82
10C Windows—Stops				26.04	.87	26.91
10D Windows—Setting fixed glass	8.75	157.68	166.43	2.50	157.68	160.18
10E1 Windows—Trim—Inside	70.04	21.84	91.88	40.41	10.08	50.49
10E2 Windows—Trim—Outside	50.75	34.74	85.48	52.32	33.26	85.58
11 Wiring		470.75	470.75		470.75	470.75
12A Insulation—Ceiling	5.39	73.60	78.99	9.00	79.73	88.73
12B Insulation—Side walls	10.00	39.33	49.33	13.75	39.34	53.09
13A Wallboard—Back-up	17.78	5.80	23.58	21.90	12.43	34.33
13B Wallboard—Ceiling	37.86	71.10	109.06	21.69	68.80	90.49
13C Wallboard—Side walls	30.23	50.30	80.53	37.69	50.60	88.29
13D Wallboard—Partitions	81.14	95.12	176.26	58.64	79.05	137.69
13E Wallboard—Taping	148.83	17.00	165.83	85.15	17.00	102.15
13F Wallboard—Trim	75.07	63.76	138.83	79.53	60.88	140.41
14A Doors—Jamb	37.54	48.93	86.47	39.84	33.98	73.82
14B Doors—Trim	64.97	19.62	84.59	41.79	23.34	65.13
14C Doors—Hanging (hinges)	47.61	12.99	60.60	77.09	12.51	89.60
14D Doors—Hardware (locksets)	21.65	333.17	354.82	14.36	308.56	322.92
15A1 Septic Tanks—Dist. box	110.88	86.10	196.98	36.08	86.10	122.18
15A2 Septic Tanks—Field	116.33		116.33	255.59		255.59
16A1 Cabinets—Kitchen—Base	89.62	123.96	213.58	92.13	114.35	206.48
16A2 Cabinets—Kitchen—Wall	148.63	77.96	226.59	109.93	103.13	213.06
16B Cabinets—Utility	8.83	1.90	10.73	5.85	.60	6.45
16C Cabinets—Bath	39.00	13.12	52.12	31.85	25.71	57.56
16D Cabinets—Telephone recess	5.00		5.00	7.80		7.80
17A Clo. wall units—Framework	144.66	103.17	247.83	134.04	82.97	217.01
17B1 Clo. wall units—Door—Making	9.10	1.25	10.35		1.25	1.25
17B2 Clo. wall units—Doors—Installation	8.45	148.75	157.20	10.40	148.00	158.40
17C Clo. wall units—Freestanding	170.83	174.20	345.03	159.83	204.17	364.00
18 Painting			728.00			728.00
19A Flue (prefabricated)	41.23	64.00	105.23	15.14	61.66	76.80
20 Plumbing			960.50			960.50
21 Heating			596.70			596.70
22A Garages—Floor	170.26	175.07	345.33	203.50	162.71	366.21
22B Garages—Walls	117.09	213.33	330.42	99.73	154.34	254.07
22C Garages—Roof	209.94	337.48	547.42	136.00	221.37	357.37
22D Garages—Doors and windows	13.76	6.72	20.48	89.51	92.57	182.08
23A Walks	6.01	3.48	9.49	50.88	34.42	85.30
23B Drives	19.26	116.05	135.31	19.74	59.97	79.71
23C Stoops	34.05	39.62	73.67	28.56	36.55	65.11
23E Fence	68.00	54.32	122.32	76.39	81.05	157.44
24A Rough grading—Rough	48.88	32.00	80.88	31.20	52.00	83.20
24B Rough grading—Finish	45.63	20.75	66.38	64.50	20.75	85.25
26A Bath tile					1.20	1.20
27 Storm windows	11.70	116.66	128.36	28.60	115.04	143.64
30 Miscellaneous	131.07	161.41	292.48	64.97	64.19	129.16
Totals excluding plumbing, heating, painting, checked items	3,168.61	4,679.55	7,848.19	2,901.79	4,640.96	7,542.75
Totals excluding checked items only			10,133.39			9,827.95
Totals including checked items			12,330.76			12,074.58

PART III

Assembly Procedures, and Material and Labor-Time Records During Construction — House A

The procedures followed by the contractor during the building of the first demonstration house (House A) are reported in this section. Materials used and labor time are recorded for each individual component, following the "Outline for Components of Labor and Material Study," (page 5). Details of the particular component are shown, where feasible, for ready reference and comparison.

These details, and materials and labor-time records provide the necessary data for detailed comparisons of a builder's current practices and costs, and form the basis for judgment as to the successful demonstration of benefits in the new techniques used.

For some components, improvements in construction procedures were made during the erection of the second demonstration house (House B). Where such changes occurred, the methods are discussed herein.

Component 1.—Earth Preparation

COMPONENT 1.—EARTH PREPARATION (HOUSE A)

A.—SCRAPE 1.—MACHINE

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Machine and operator	6-4	1	2	$11.00	$22.00
Total labor					22.00
Total material					None
Total labor and material					22.00

Component 2.—Layout

House and Site Layout.—House A is located on the north side of a street running east and west. Since the house plan is designed so that principal living areas will face south (see "Solar Orientation"), this puts the living area to the south facing the street. To achieve maximum privacy for the living room and the outdoor living area, a screen fencing was designed and erected as an integral part of the structure.

COMPONENT 2.—LAYOUT (HOUSE A)

A.—TOTAL TIME (MEASURING, STAKING, ETC.)

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Foreman	6-4	2	4½	$2.50	$11.25
Helpers	6-4	2	5	1.50	7.50
Total labor					18.75
Total material (scrap from previous jobs)					None
Total labor and material					18.75

B. BATTER BOARDS

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Foreman	6-4	2	3	$2.50	$7.50
Helpers	6-4	2	3	1.50	4.50
Total labor					12.00
Total material (scrap)					None
Total labor and material					12.00

Component 3.—Excavation

COMPONENT 3.—EXCAVATION (HOUSE A)

A.—TRENCHING FOR FOOTINGS 2.—HAND LABOR

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	6-5	4	23	$1.85	$42.55
Do	6-5	1	6	1.85	11.10
Total labor					53.65
Total material					None
Total labor and material					53.65

Component 4.—Foundation

Foundation.—The footings were 8″ x 16″ poured concrete. To accomplish this the trenches were dug by hand and the concrete poured directly into the footing trenches. This eliminated the use of any footing forms. It will be noted on the

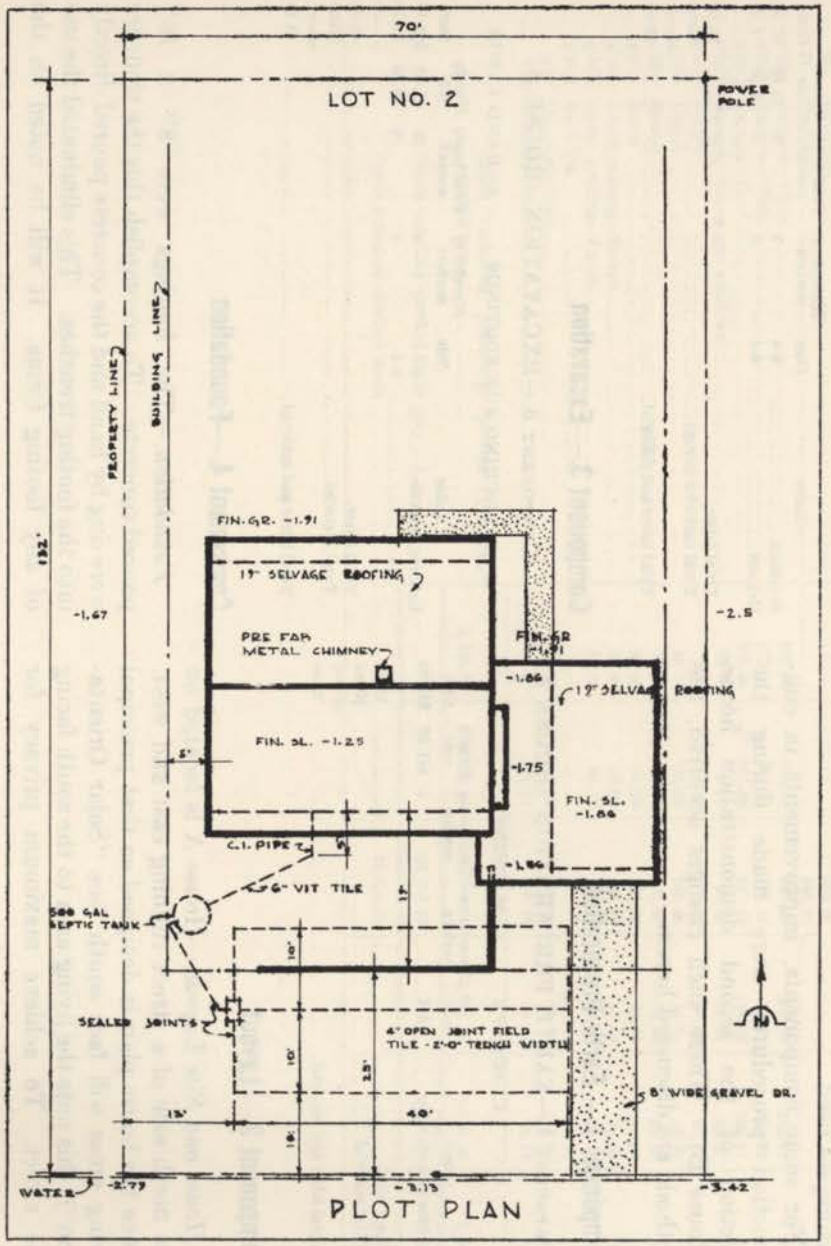


FIGURE 6.—*House A plot plan.*

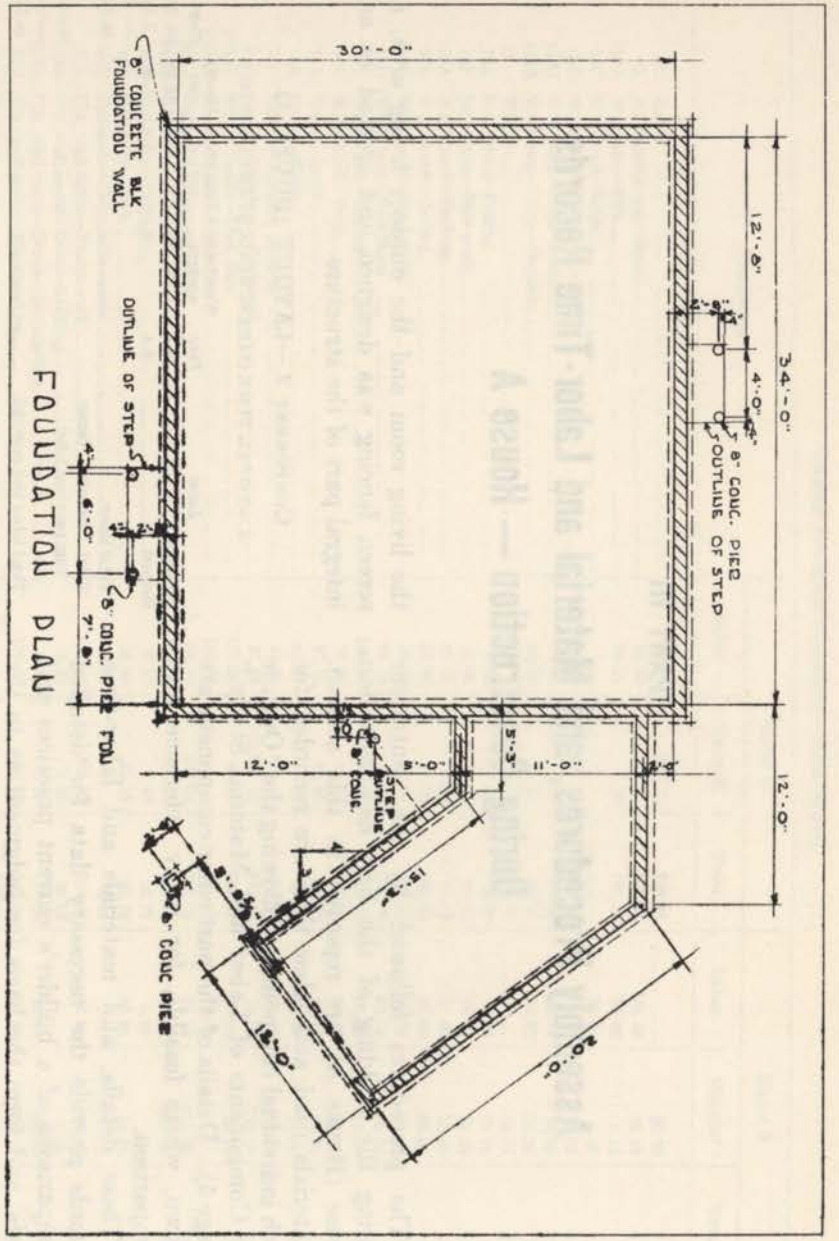


FIGURE 7.—*House A foundation plan.*

drawings that the top block is of solid precast concrete, 4″ at the top to receive the bottom plate and 8″ at the bottom. This block, even though a form had to be made and the blocks cast individually on the job, is more desirable to use than other details where 4″ solid blocks are used on the top course. The mason, in setting the top blocks, used wooden wedges to aline the blocks and a mortar gun to force the mortar into the joints. This method simplifies the placing of the insulation. The insulation was placed against the foundation wall in the horizontal position and no cutting was necessary. Earth was tamped against the lower edge to hold the insulation in place until the gravel was dumped and the concrete poured. One-half inch anchor bolts were placed 8 feet on center in the foundation wall.

Component 4.—FOUNDATION (HOUSE A)

A.—FORMS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-18	1	3¼	$2.50	$8.13
Total labor					8.13
Total material					None
Total labor and material					8.13

B.—FOOTING (CONCRETE)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-6	1	1½	$1.85	$2.77
Laborer, unskilled	6-6	3	2½	1.85	4.63
Cement finisher, skilled	6-6	1	1¾	2.75	4.81
Total labor					12.21

Material	Date	Amount in units	Amount used	Price per unit	Cost
Concrete 1-2-4	6-6	10820#	2.71 cu. yd.	$13.00	$35.23
Concrete 1-3-5	6-6	11150#	2.79 cu. yd.	12.10	33.76
Total material					$68.99
Total labor and material					81.20

C.—FOUNDATION BLOCK OR POURED CONCRETE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-6	1	2	$1.85	$3.70
Laborer, skilled	6-7	1	3	2.00	6.00
Laborer, unskilled	6-7	1	2½	1.85	4.63
Mason, skilled	6-7	2	4	3.25	13.00
Laborer, unskilled	6-9	1	¾	1.85	1.39
Laborer, skilled	6-9	1	6¾	2.00	13.75
Laborer, unskilled	6-9	1	3	1.85	5.55
Mason, skilled	6-9	1	6	3.25	19.50
Laborer, skilled	6-10	3	3	2.00	6.00
Laborer, skilled	6-11	3	14	2.00	28.00
Laborer, unskilled	6-12	3	7½	1.85	13.88
Mason, skilled	6-12	2	4	3.25	13.00
Laborer, unskilled	6-13	3	1½	1.85	2.76
Laborer, skilled	6-13	1	1¼	2.00	2.50
Mason, skilled	6-13	1	2¾	3.25	8.93
Laborer, skilled	6-14	3	1¾	2.00	3.50
Laborer, unskilled	6-14	2	3	1.85	5.55
Mason, skilled	6-14	1	2½	3.25	8.12

Component 4.—FOUNDATION (HOUSE A)—Con.

C.—FOUNDATION BLOCK OR POURED CONCRETE—Continued

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, skilled	6-16	1	1	$2.00	$2.00
Laborer, unskilled	6-16	1	¾	1.85	1.39
Cement finisher	6-16	1	1½	2.75	4.13
Total labor					167.28

Material	Date	Amount in units	Amount used	Price per unit	Cost
Concrete blocks 8 x 8 x 16	6-6	298	298	$0.20½	$61.09
Mortar	6-6	7 sacks	7 sacks	1.07	7.49
Fine sand	6-6	3,400#	1.70 cu. yd.	3.40	5.78
Concrete blocks 4 x 8 x 16	6-6	98	98	.17½	17.15
Cement	6-11	6 sacks	6 sacks	1.30	7.80
Pea gravel	6-11	2,010#	1.01 cu. yd.	3.65	3.69
Fine sand	6-11	800#	.40 cu. yd.	3.40	1.36
Do	6-13	1,320#	.66 cu. yd.	3.40	2.24
Brick mortar	6-14	3 sacks	3 sacks	1.20	3.60
Cement	6-14	1 sack	1 sack	1.30	1.30
Pea gravel	6-9	3,020#	1.51 cu. yd.	3.65	5.52
Cement	6-9	4 sacks	4 sacks	1.30	5.20
Fine sand	6-9	820#	.41 cu. yd.	3.40	1.39
Total material					123.61
Total labor and material					290.89

D.—INSULATION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-14	4	3½	$1.85	$6.48
Total labor					6.48

Material	Date	Amount in units	Amount used	Price per unit	Cost
Perimeter-A. E. insulation, 1″ x 12″ x 36″.	6-14	288 sq. ft.	8 ctns.	$0.21	$60.48
Total material					60.48
Total labor and material					66.96

E.—TERMITE SHIELD

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	6-24	1	¼	$2.75	$0.69
Carpenter, skilled	6-24	1	¼	2.50	.63
Carpenter, foreman	6-25	1	¼	2.75	.69
Carpenter, skilled	6-25	1	¼	2.50	.63
Carpenter, skilled	6-26	1	¼	2.50	.63
Total labor					3.27

Material	Date	Amount in units	Amount used	Price per unit	Cost
10″-3 oz. copper-coated Kraft paper.	6-24	1 roll	120 lin. ft.	$0.18¾	$22.50
Total material					22.50
Total labor and material					25.77

F.—ANCHOR BOLTS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Total labor					None

Material	Date	Amount in units	Amount used	Price per unit	Cost
½″ x 10″ machine bolts	6-12	20		$0.15	$3.00
⅛″ x 2½″ washers	6-27	10 pcs.			.93
Total material					3.93
Total labor and material					3.93

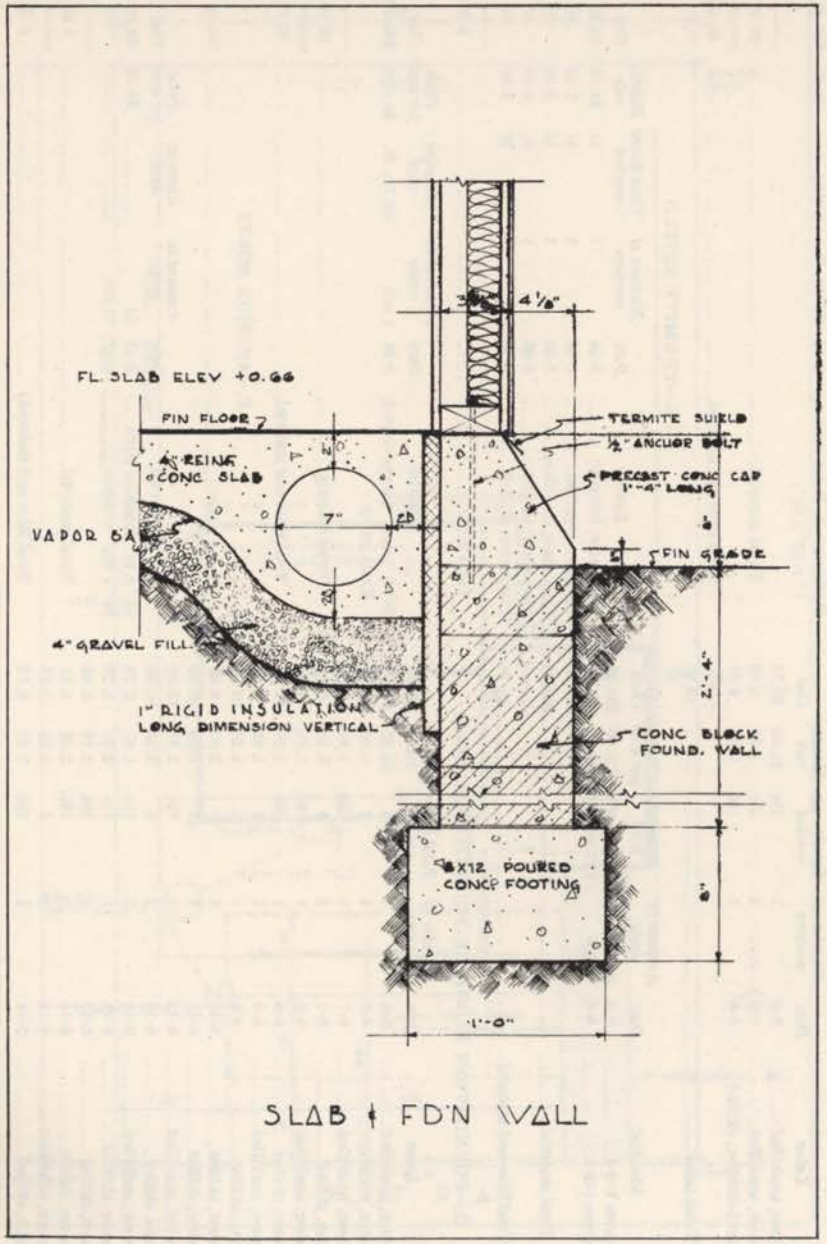


FIGURE 8.

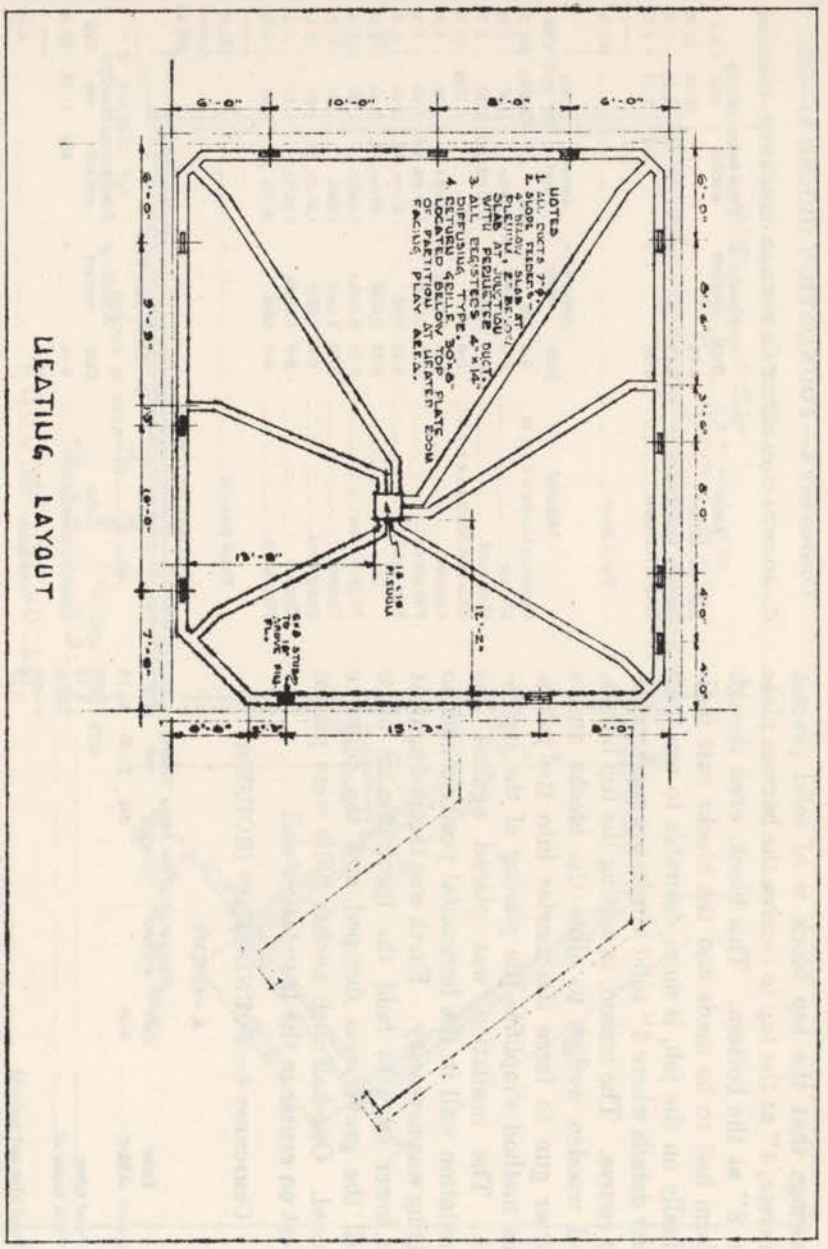


FIGURE 9.

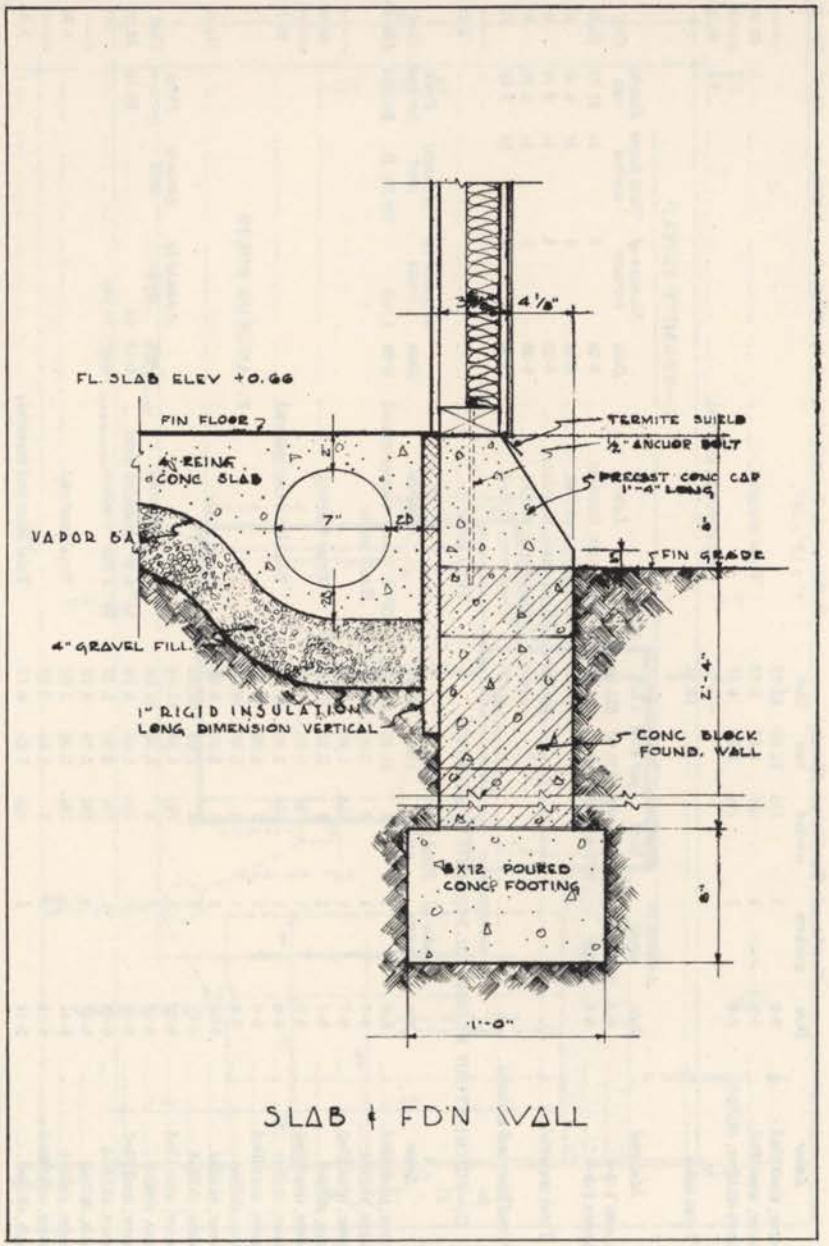


FIGURE 8.

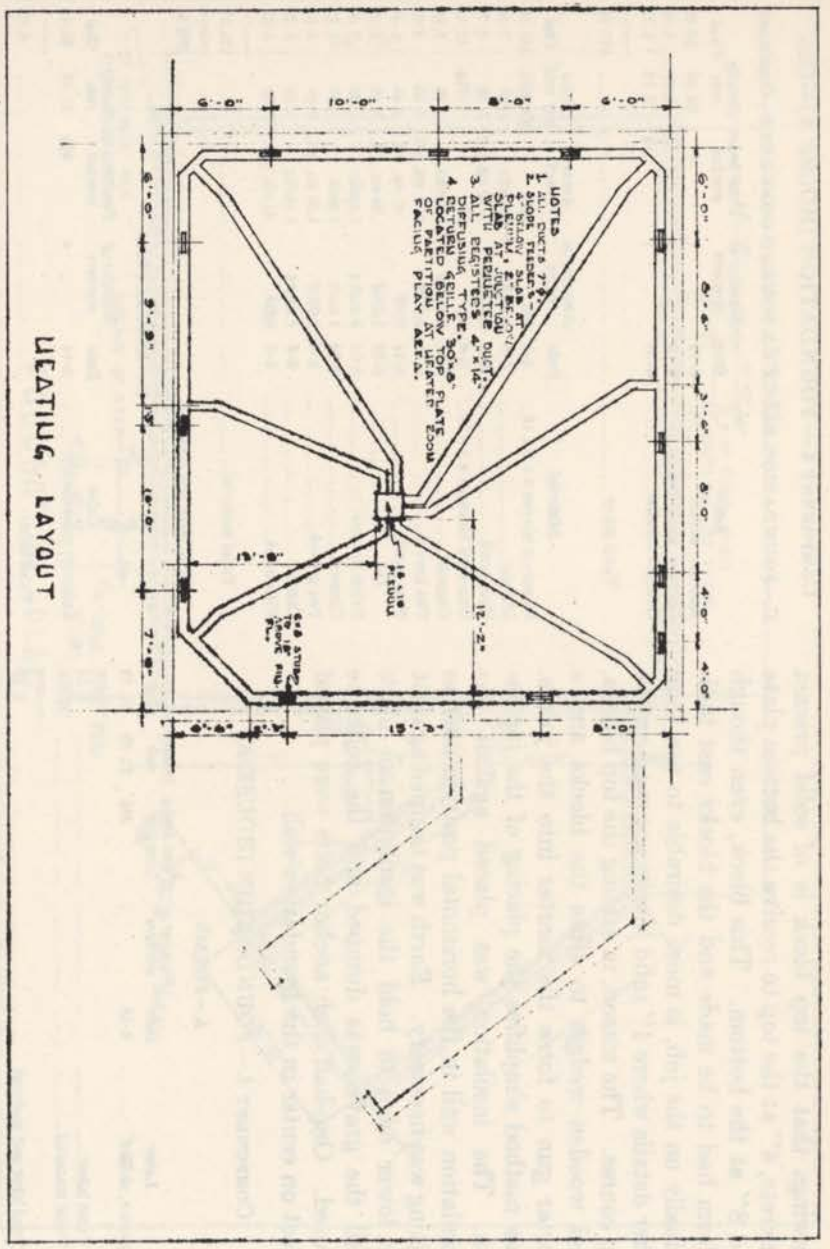


FIGURE 9.

Component 5.—Floor

A—Duct Work Placing.—A radial perimeter warm-air heating system was used. The warm-air distribution system was a 7″ fibre duct with metal fittings—i. e., elbows, T's and plenum chamber. The ducts were available commercially in lengths of 18′, and in all cases the longest possible duct was used to eliminate as many joints as possible. Where joints did occur, pressure-sensitive tape was used to hold the ducts together.

To install the ducts, trenches were made in the gravel fill prior to the placing of the vapor barrier. For House A, the ducts were then prefitted, numbered, and removed. Concrete was poured in the trench on top of the vapor barrier. The ducts were then assembled in position and weighted down so they were more than half covered with concrete. (The weights were removed after the concrete had set enough to hold the ducts in place.) To eliminate a concentrated warm floor area in the vicinity of the furnace, the ducts at this point were placed 5″ below the finish-floor level. With a very gradual rise in the radials toward the perimeter ducts, this distance decreased to 2 inches.

To facilitate the installation of the 2″ x 14″ and the 4″ x 14″ diffusing-type registers, register boots that had been prefabricated in the subcontractor's shop were used. These were fastened directly to the ducts. Caps on the boots were knocked out and the ducts cut after the concrete was poured.

B, C, D—Floor Slab.—The concrete slab was poured over tamped earth, 4″ of pit-run gravel, and 4″ of washed gravel. The gravel was dumped inside the foundation wall, after the roughing-in plumbing work had been finished. Hand labor spread this gravel to an overall depth of 4″ mentioned above. The vapor barrier used was a kraft paper with an asphalt center. It was placed directly over the washed gravel. With this in place, the heat duct was installed as described under Component 5A—Duct Work Placing.

The next step was the placing of the 6″ x 6″ No. 10 welded wire mesh that was used to reinforce the concrete slab. When the concrete was delivered, the truck drove along the outside of the foundation wall and by using different lengths on the discharge chute, placed the concrete with a minimum of hand labor. Finishing was carried on by cement finishers using an electrically-driven finishing machine.

Component 5.—Floor (House A)

A.—Duct Work Placing

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	6-14	1	1	$1.85	$1.85
Laborer, skilled	6-14	1	1	2.00	2.00
Laborer, unskilled	6-14	4	5	1.85	9.25
Do	6-18	2	7	1.85	12.95
Laborer, skilled	6-18	2	7	2.00	14.00
Do	6-19	1	¾	2.00	1.50
Laborer, unskilled	6-19	2	2	1.85	3.70
Total labor					45.25

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
7″—90 ells	6-16	8 pcs.		$0.90	$7.20
7″—2-pc. angles	6-16	10 pcs.		.75	7.50
½ x 10 metal screws	6-16	1 box		.30	.30
7″ x 18′—0″ fiber ducts	6-17	13 molds	234 lin. ft.	.32	74.88
1-3-5 concrete	6-18	14,160#	3.54 cu. yd.	12.10	42.83
Total material					132.71
Total labor and material					177.96

B.—Fill 1.—Earth

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	6-10	2	1½	$1.85	$2.78
Do	6-11	3	2½	1.85	4.63
Do	6-16	1	1¼	1.85	2.31
Total labor					9.72
Total material					None
Total labor and material					9.72

2.—Gravel

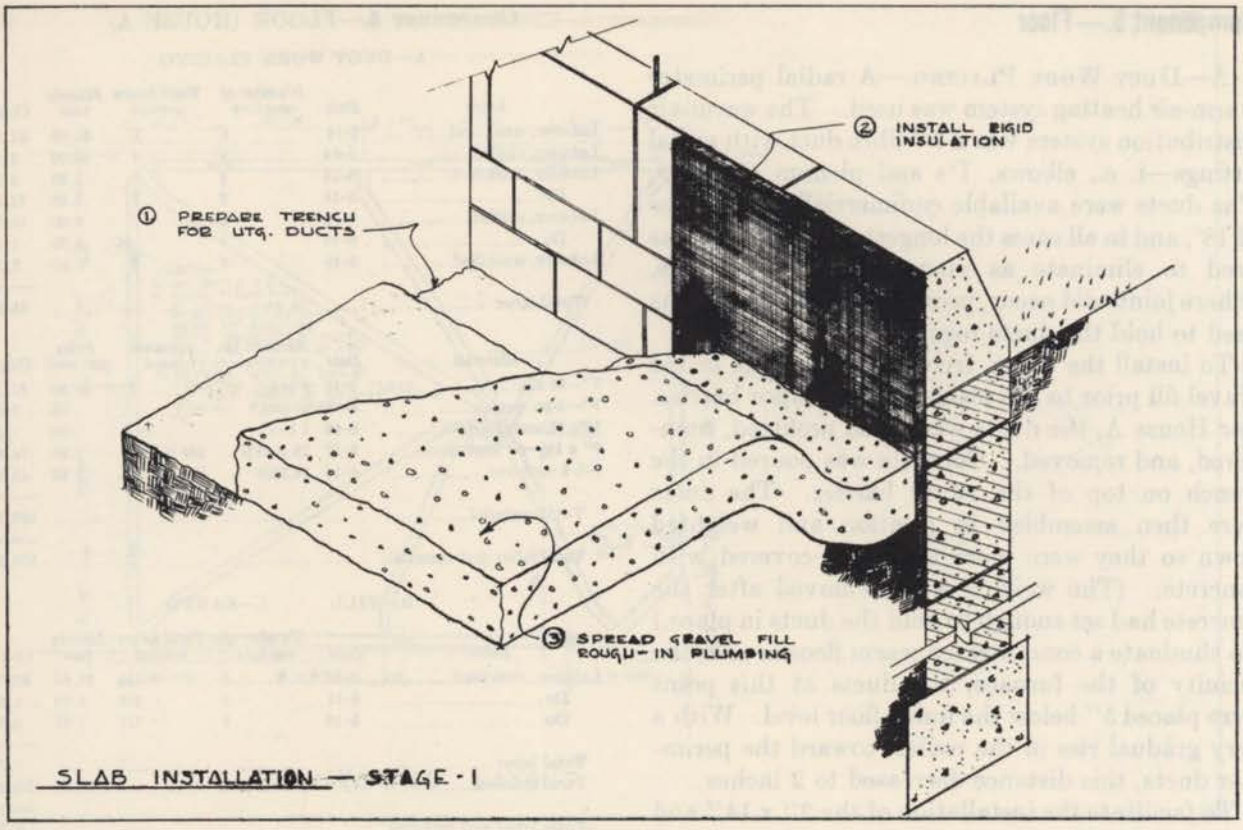
Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	6-12	1	1½	$1.85	$2.78
Do	6-13	5	14	1.85	25.90
Machine operator	6-13	1	¾	7.50	5.63
Laborer, unskilled	6-13	6	14½	1.85	26.83
Do	6-14	4	14½	1.85	26.83
Do	6-14	2	1½	1.85	2.78
Total labor					90.75

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
Gravel	6-11	5 cu. yds.	5 cu. yds.	$1.60	$8.00
Do	6-12	5 cu. yds.	5 cu. yds.	1.60	8.00
Do	6-13	10 cu. yds.	10 cu. yds.	1.60	16.00
Do	6-13	20 cu. yds.	20 cu. yds.	1.60	32.00
Total material					64.00
Total labor and material					154.75

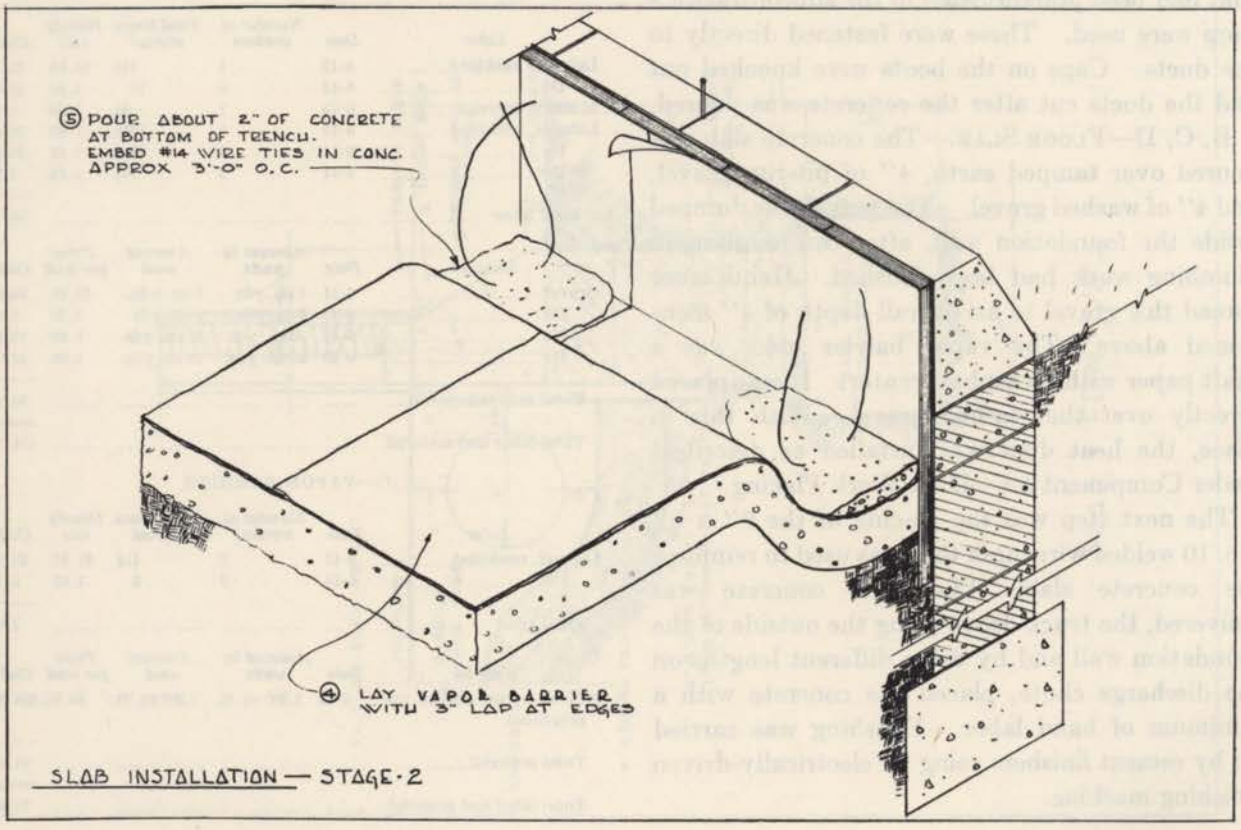
C.—Vapor Barrier

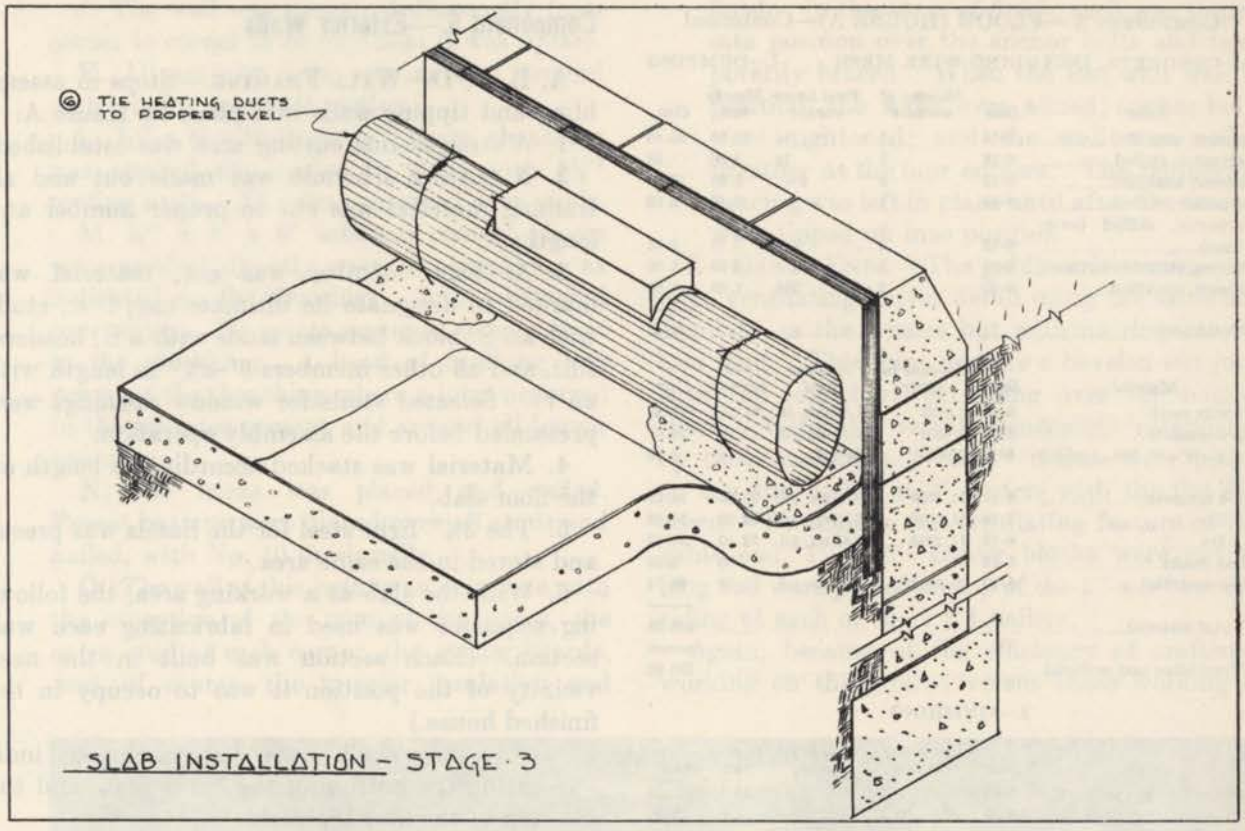
Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	6-17	3	1¼	$1.85	$2.31
Do	6-18	2	3	1.85	5.55
Total labor					7.86

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
8′ Kraft-paper, asphalt impregnated.	6-16	1,200 sq. ft.	1,200 sq. ft.	$0.02	$24.00
Total material					24.00
Total labor and material					31.86

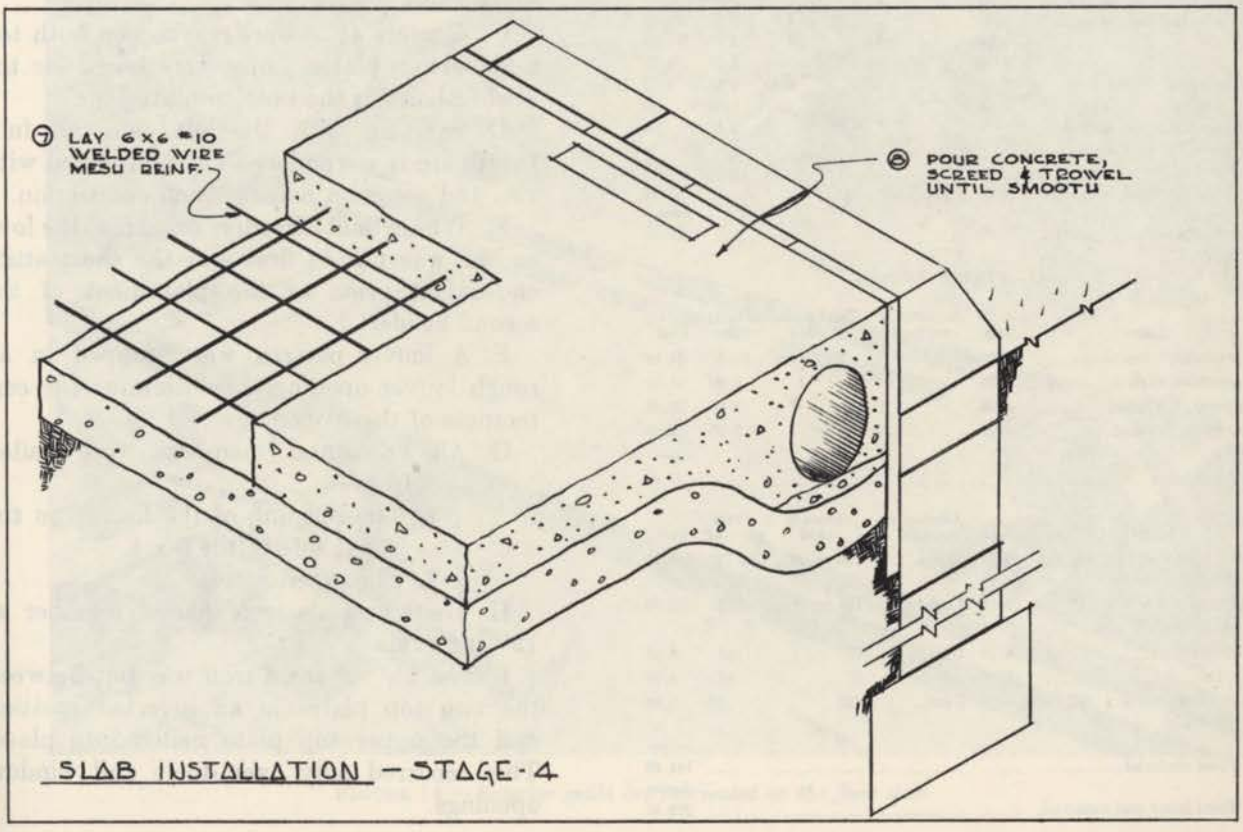


FIGURES 10 *(above) and* 11 *(below).*





FIGURES 12 *(above)* and 13 *(below)*.



COMPONENT 5.—FLOOR (HOUSE A)—Continued

D.—CONCRETE, INCLUDING WIRE MESH 1.—DUMPING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-18	1	¼	$1.85	$0.46
Carpenter, skilled	6-18	1	¼	2.50	.63
Laborer, unskilled	6-19	3	9¼	1.85	17.11
Carpenter, skilled	6-19	1	2	2.50	5.00
Carpenter, skilled (overtime)	6-18	1	1	3.75	3.75
Laborer, skilled (overtime)	6-18	1	1	3.00	3.00
Laborer, unskilled	6-20	2	2½	1.85	4.63
Total labor					34.58

Material	Date	Amount in units	Amount used	Price per unit	Cost
#10 wire mesh	6-16	2 rolls	1,500 sq. ft.	$0.0275	$41.25
1-3-5 concrete	6-19	8, 580#	2.15 cu. yd.	12.10	26.02
2 x 4—18′—0″ No. 1 and 2 fir.	6-19	2 pcs.	24 BF	.145	3.48
1-3-5 concrete	6-19	11, 470#	2.87 cu. yd.	12.10	34.73
Do	6-19	11, 300#	2.83 cu. yd.	12.10	34.24
Do	6-19	11, 270#	2.82 cu. yd.	12.10	34.12
Mesh hooks	6-19	24	24	.10	2.40
1-3-5 concrete	6-20	19, 880#	4.97 cu. yd.	12.10	60.14
Total material					236.38
Total labor and material					270.96

2.—FINISHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Cement finisher, skilled	6-19	2	10¼	$2.75	$28.19
Cement finisher, unskilled	6-19	1	2½	2.00	5.00
Cement finisher, skilled (overtime)	6-19	2	3	4.13	12.39
Cement finisher, unskilled	6-20	1	2¾	2.00	5.50
Cement finisher, skilled	6-20	1	4	2.75	11.00
Do	6-24	1	4	2.75	11.00
Do	7-16	1	3	2.75	8.25
Laborer, unskilled	7-16	1	2½	1.85	4.63
Do	7-17	1	¼	1.85	.46
Cement finisher, skilled	7-17	1	¼	2.75	.69
Total labor					87.11
Total material					None
Total labor and material					87.11

G.—FINISH FLOOR

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-26	1	1¾	$2.85	$4.99
Carpenter, skilled	8-26	3	17	2.60	44.20
Laborer, unskilled	8-26	1	7	1.50	10.50
Carpenter, skilled	8-27	2	7	2.60	18.20
Total labor					77.89

Material	Date	Amount in units	Amount used	Price per unit	Cost
B—Grade 9 x 9 x ⅛″ asphalt tile.	8-19	16 ctn.	720 sq. ft.	$0.125	$90.00
D—Grade 9 x 9 x ⅛″ asphalt tile.	8-19	3 ctn.	135 sq. ft.	.22	29.70
Adhesive	8-19	1-5 gal.	5	.81	4.05
Do	8-26	1-5 gal.	5	.81	4.05
B—Grade 9 x 9 x ⅛″ asphalt tile.	8-26	3 ctn.	135	.125	16.88
Total material					144.68
Total labor and material					222.57

Component 6.—Exterior Walls

A, B, C, D—WALL FRAMING.—Steps in assembling and tipping walls into place on House A:

1. A straight-line cutting area was established.

2. A cutting schedule was made out and all framing material was cut to proper number and lengths.

3. As each member was cut, material was marked to designate its ultimate use; i. e., studs with an S; block between studs with a B; headers, sills, and all other members 3′–8¾″ in length with an H. Selected studs for window openings were presanded before the assembly operation.

4. Material was stacked according to length on the floor slab.

5. The 3⅝″ light steel for the lintels was precut and stored in the same area.

6. With the slab as a working area, the following sequence was used in fabricating each wall section. (Each section was built in the near vicinity of the position it was to occupy in the finished house.)

A. Two chalk lines were snapped, indicating the bottom of the lower plate and the top of the first top plate.

B. Top and bottom plates were placed along these lines.

C. Centers at 2′ were marked on both top and bottom plates, holes were bored for the anchor bolts in the bottom plate.

D. Starting with the left side, all full-length studs were placed and end-nailed with two 16d common nails at each connection.

E. Where doubleheaders occurred, the lower one was put in first and the short studs end-nailed prior to the placement of the second header.

F. A louver pattern was dropped in all rough louver openings to determine the correctness of these openings.

G. All horizontal members were nailed from—

1. The opening of the louver on the flat side of the 2 x 4.
2. The exterior side.

H. Double studs were nailed together at 12″ intervals.

I. The 3⅝″ channel iron was put between the two top plates in an inverted position and the upper top plate nailed into place. This occurred only over doors and window openings.

J. The wall was measured diagonally from corner to corner to be sure that it was square.

K. All exterior trim was applied around each window or panel section.

L. ¾″ x 4′ x 8′ insulation board sheathing was applied and nailed in place with 1¼″ roofing nails. All joints occurred over studs.

M. ⅛″ x 4′ x 8′ asbestos cement sheets were applied directly over the sheathing as indicated on the drawings. Joints occurred over studs. No joints occurred over a joint in the sheathing. A bead of caulking was run over the sheathing where a joint occurred in the asbestos cement and around all louver openings.

N. The frieze was placed and nailed. Precut battens were placed over all studs and nailed, with No. 10 finish nails.

O. The wall at this point was complete with the exception of the trim at the doors, the extra stud at each corner, the corner boards, and, of course, the interior insulation and finish. In this state of finish, each was tipped into position over the anchor bolts and temporarily braced. When the last wall was in position, the walls were alined; anchor bolts were tightened; and the wall was nailed together at the four corners. The temporary bracing was left in place until after the trusses were tipped up into position.

E—Gable Ends.—The gable ends were a complete ventilating louver detail using the same size members as the trusses but with no rings at the heel joint. This joint became a beveled cut joint with the top chord extending over the bottom chord. With the overall dimensions established by these members, 2″ x 4″ nailers were placed on top and nailed at 2′ centers with the flat side down. To achieve the ventilating feature of this gable end, 1″ x 6″ spacer blocks were cut 4″ long and were placed on top of the 1″ x 8″ beveled siding at each of the 2 x 4 nailers.

Again, because of the efficiency of craftsmen working on the ground versus those working on

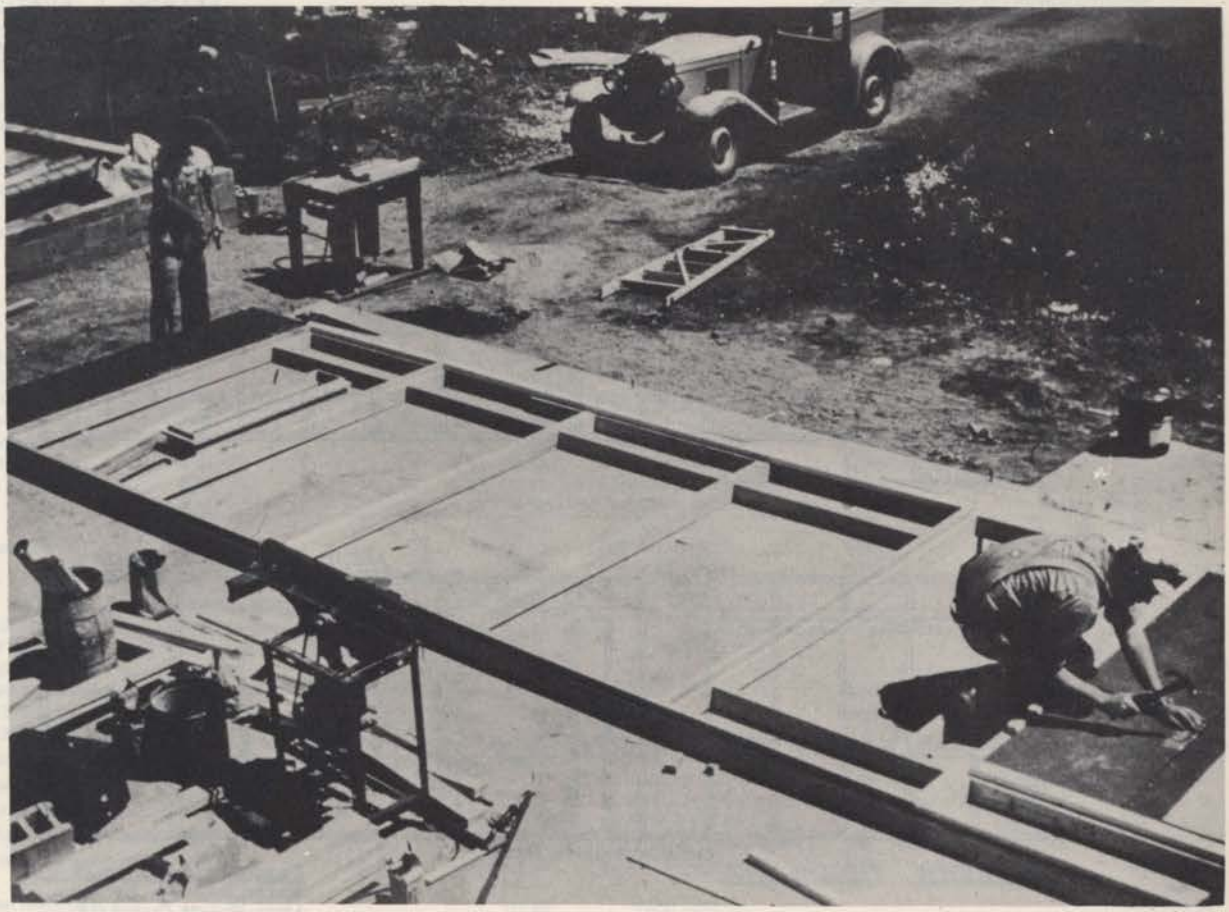
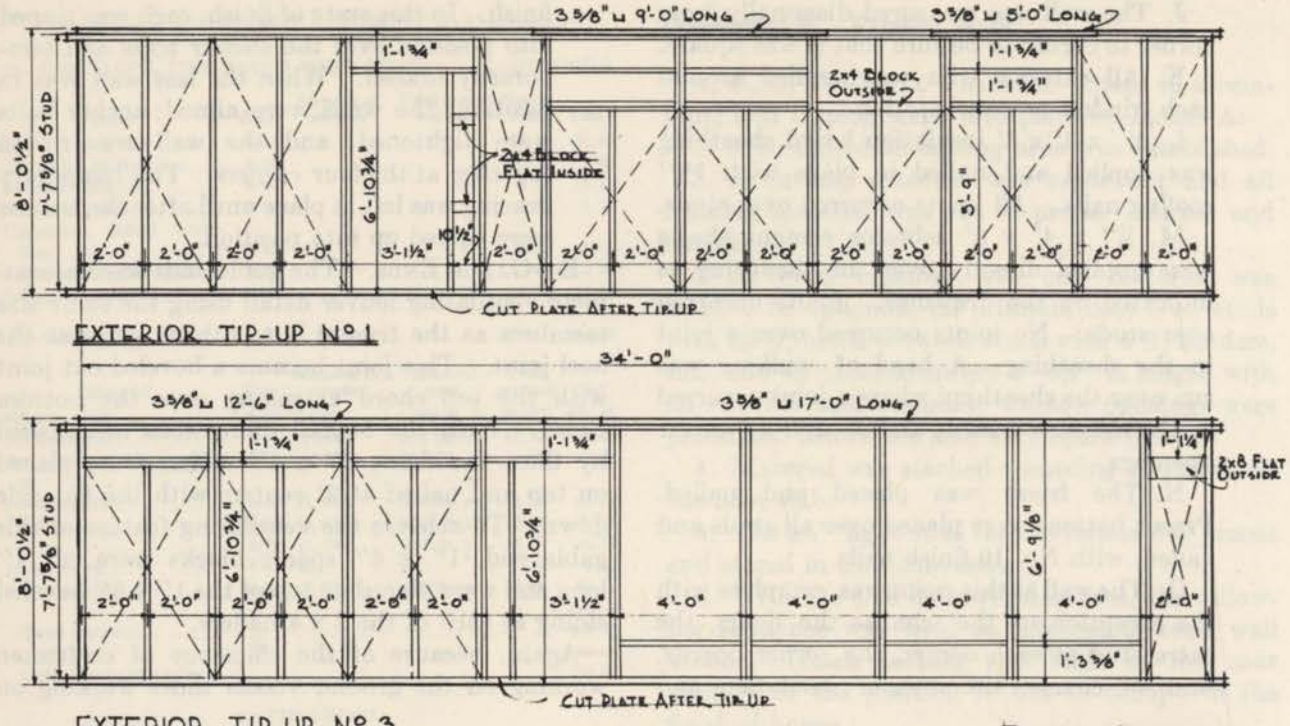
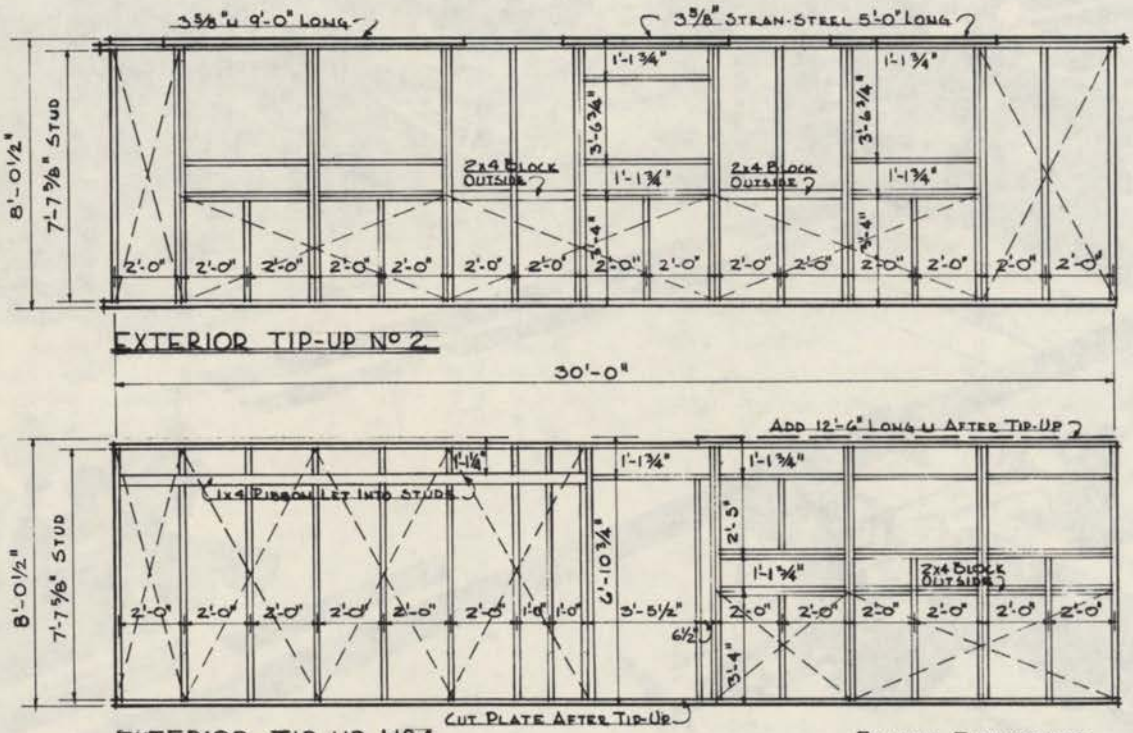


Figure 14.—*Exterior walls are fabricated on the floor slab.*



FRAMING ELEVATIONS
NOTE: DIAGONAL BROKEN LINES INDICATE PANELS OF 1/8" ASBESTOS CEMENT SIDING

FIGURE 15.



FRAMING ELEVATIONS
NOTE: DIAGONAL BROKEN LINES INDICATE PANELS OF 1/8" ASBESTOS CEMENT SIDING

FIGURE 16.

scaffolding, the entire gable end was constructed on the floor and then put into place. In the sequence of operations, two gables were constructed and hung on each end wall prior to the starting of the truss assembly operation. During actual tip-up work, one gable end was tipped into place and secured; trusses were then tipped and nailed at the heel joint; and a temporary brace was run on top of the top chord approximately half-way to the peak joint on each side.

When the first 13 trusses were in place and nailed, the last 3 were tipped and placed near the last upright trusses. This left ample room for the tipping of the second gable end. After it was in place, the 3 trusses were moved along the top plate to their respective positions and securely fastened.

F—Louvers.—Window louvers as detailed in figures 18 and 19 were built on the job by the carpenters. Mill assembly would probably have been no more—and possibly less—expensive.

Component 6.—EXTERIOR WALLS (HOUSE A)

A.—WALL FRAMING — 0.—PRECUTTING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-21	2	3½	$2.50	$8.75
Carpenter, unskilled	6-21	2	3½	1.75	6.13
Total labor					14.88
Total material					none
Total labor and material					14.88

A.—WALL FRAMING — 1.—BUILDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	6-24	1	2	$2.75	$5.50
Carpenter, skilled	6-24	1	2	2.50	5.00
Carpenter, foreman	6-25	1	1¾	2.75	4.81
Carpenter, skilled	6-25	1	2¼	2.50	5.63
Carpenter, foreman	6-26	1	1	2.75	2.75
Carpenter, skilled	6-26	3	4¼	2.50	10.63
Do	6-30	3	1¼	2.50	3.13
Do	7-10	1	2½	2.50	6.25
Total labor					43.70

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 16′ No. 1 and 2 fir	6-20	39 pcs.	416 bd.-ft.	$0.145	$60.32
2 x 4 x 8′ No. 1 and 2 fir	6-20	1 pc.	5 bd.-ft.	.145	.77
2 x 4 x 16′ No. 1 and 2 fir	6-20	12 pcs.	128 bd.-ft.	.145	18.56
2 x 4 x 18′ No. 1 and 2 fir	6-20	33 pcs.	396 bd.-ft.	.145	57.42
1 x 4 x 12′ No. 1 and 2 fir	6-20	1 pc.	4 bd.-ft.	.145	.54
2 x 4 x 12′ No. 1 and 2 fir	7-1	1 pc.	8 bd.-ft.	.145	1.16
20′ strand steel perforated channel.	6-30	5 pcs.	99′ 6″ lin. ft.	.30	29.85
Aluminum flashings	7-2	4 pcs.	18′ lin. ft.		6.00
2 x 4 x 14′ No. 1 and 2 fir	7-14	1 pc.	9 bd.-ft.	.145	1.31
2 x 4 x 12′ No. 1 and 2 fir	7-14	1 pc.	8 bd.-ft.	.145	1.16
Total material					177.09
Total labor and material					220.79

Component 6.—EXTERIOR WALLS (HOUSE A)—Con.

A.—WALL FRAMING — 2.—ERECTION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Foreman		1	½	$2.75	$1.38
Carpener, skilled	6-24	1	½	2.50	1.25
Laborer, unskilled	6-24	4	2	1.85	3.70
Carpenter, foreman	6-25	1	¾	2.75	2.06
Carpenter, skilled	6-25	1	¾	2.50	1.88
Laborer, unskilled	6-25	4	3	1.85	5.55
Carpenter, foreman	6-26	1	¼	2.75	.69
Do	6-26	3	1¾	2.50	4.38
Laborer, unskilled	6-26	3	¾	1.85	1.39
Carpenter, skilled	6-27	2	2	2.50	5.00
Carpenter, skilled	6-30	3	3	2.50	7.50
Laborer, unskilled	6-30	1	½	1.85	.93
Carpenter, skilled	7-1	2	11	2.50	27.50
Laborer, unskilled	7-1	1	¾	1.85	1.39
Carpenter, foreman	7-1	1	¼	2.75	.69
Total labor					65.29
Total material					None
Total labor and material					65.29

B.—SHEATHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	6-24	1	1¼	$2.75	$3.44
Carpenter, skilled	6-24	1	1¼	2.50	3.13
Carpenter, foreman	6-25	1	1	2.75	2.75
Carpenter, skilled	6-25	1	1	2.50	2.50
Do	6-26	3	1¾	2.50	4.38
Total labor					16.20

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 8 x 25/32 insulation board	6-20	19 pcs.	608 sq. ft.	$0.12	$72.96
2 x 8 x 25/32 insulation board	6-26	2 pcs.	32 sq. ft.	.12	3.84
Total material					76.80
Total labor and material					$93.00

D.—SIDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-21	2	1¾	$2.50	$4.39
Carpenter, unskilled	6-21	2	3	1.75	5.25
Carpenter, foreman	6-24	1	2	2.75	5.50
Carpenter, skilled	6-24	1	2	2.50	5.00
Carpenter, foreman	6-25	1	2	2.75	5.50
Carpenter, skilled	6-25	1	1¾	2.50	4.38
Do	6-26	3	2¼	2.50	5.63
Carpenter, foreman	7-11	1	¼	2.75	.69
Carpenter, skilled	7-14	2	6¼	2.50	15.63
Laborer, unskilled	7-14	1	1	1.85	1.85
Carpenter, skilled	7-15	2	8½	2.50	21.25
Do	7-16	2	1½	2.50	3.75
Laborer, unskilled	7-16	1	¼	1.85	.46
Carpenter, skilled	7-17	1	¼	2.50	.63
Do	8-13	1	¼	2.50	.63
Do	6-30	2	1½	2.50	3.75
Total labor					$84.29

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 16′	6-20	1 pc.	8 bd. -ft.	$0.135	$1.08
4 x 8 x 1/8″ asbestos cement	6-26	2 pcs.	64 sq. ft.	.115	7.36
4 x 8 x 1/8″ asbestos cement	6-27	2 pcs.	64 sq. ft.	.115	7.36
1 x 6 x 8′—0″ CVG fir (0)	6-30	4 pcs.	16 bd.-ft.	.34	5.44
1 x 8 x 8′—0″ CVG fir (0)	6-30	4 pcs.	21 bd. -ft.	.34	7.18
1 x 6 x 8′ CVG fir	7-14	1 pc.	4 bd. -ft.	.34	1.36
4 x 8 x 1/8″ asbestos cement	6-20	19 pcs.	608 sq. ft.	.115	69.92
4 x 8 x 1/8″ hardboard	7-28	3 sheets	96 sq. ft.	.11	10.56
Total material					110.26
Total labor and material					194.55

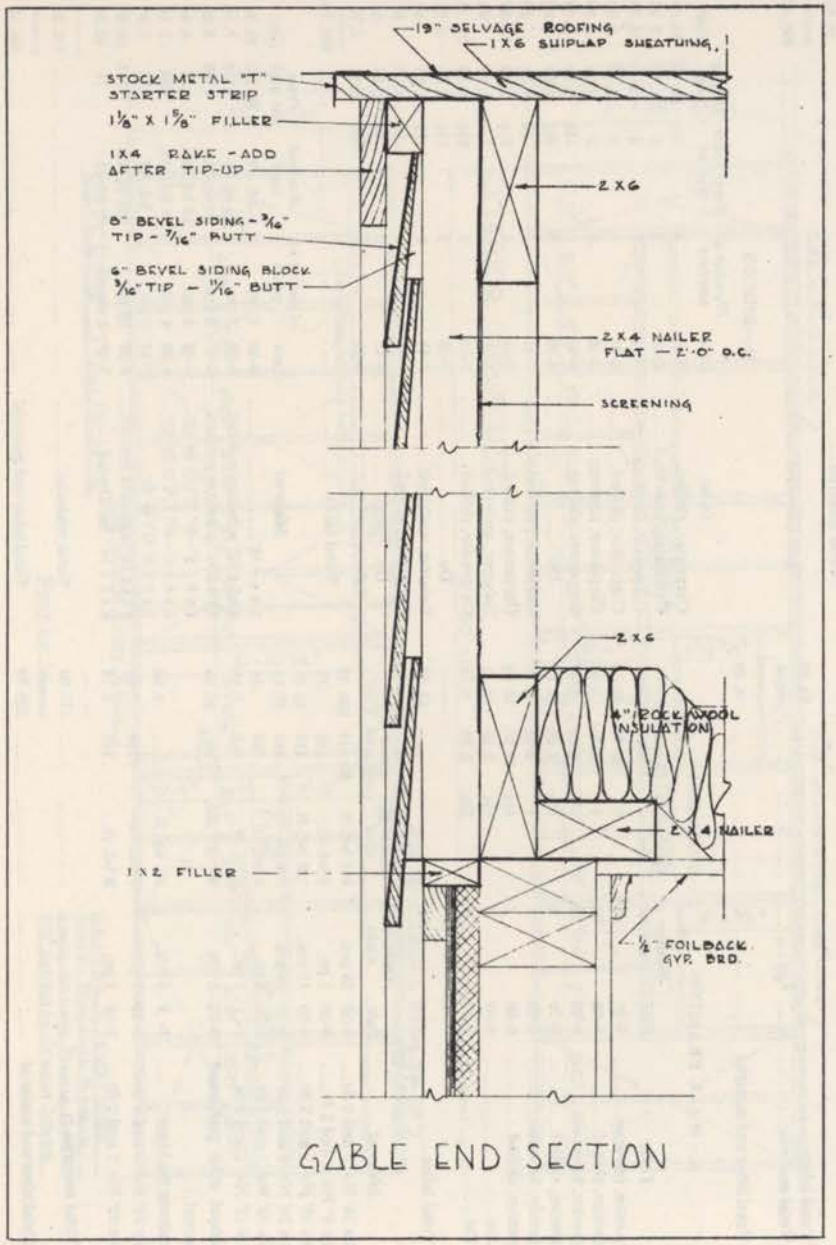


FIGURE 17.

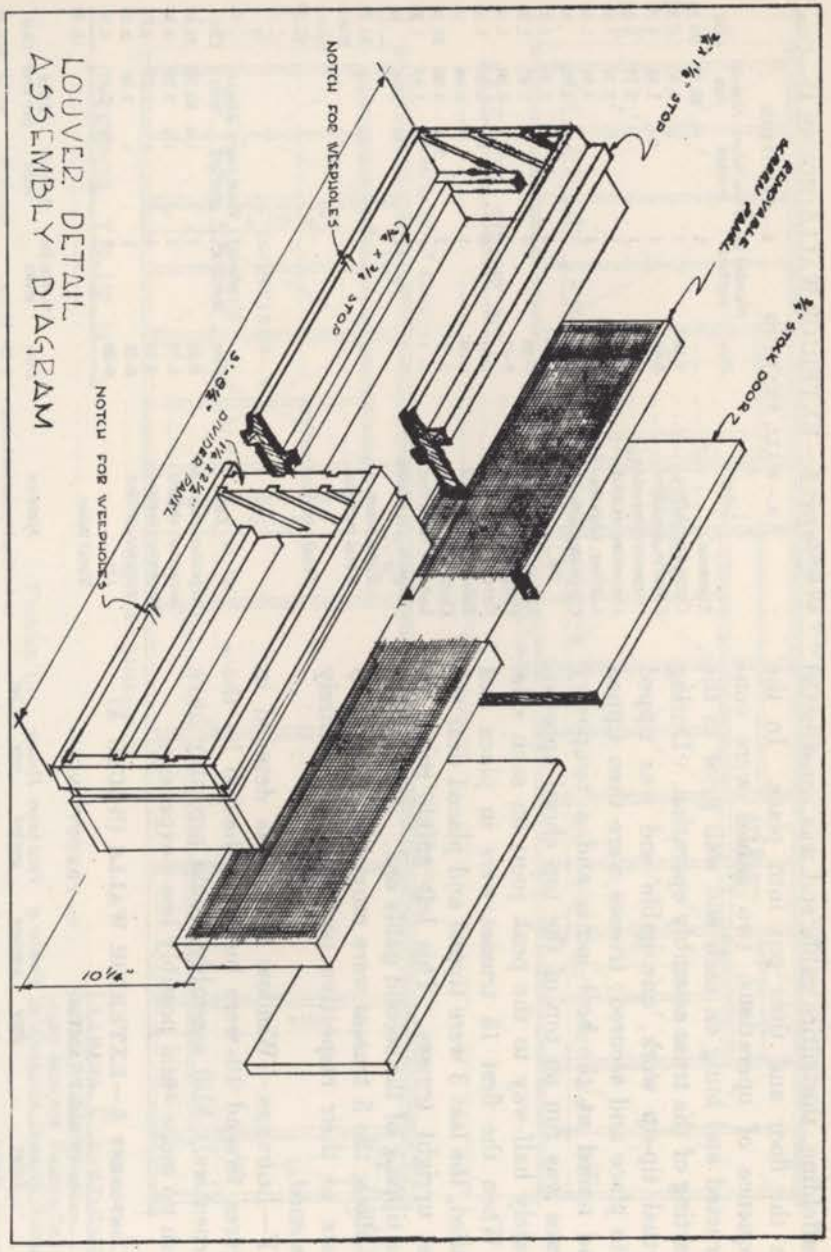
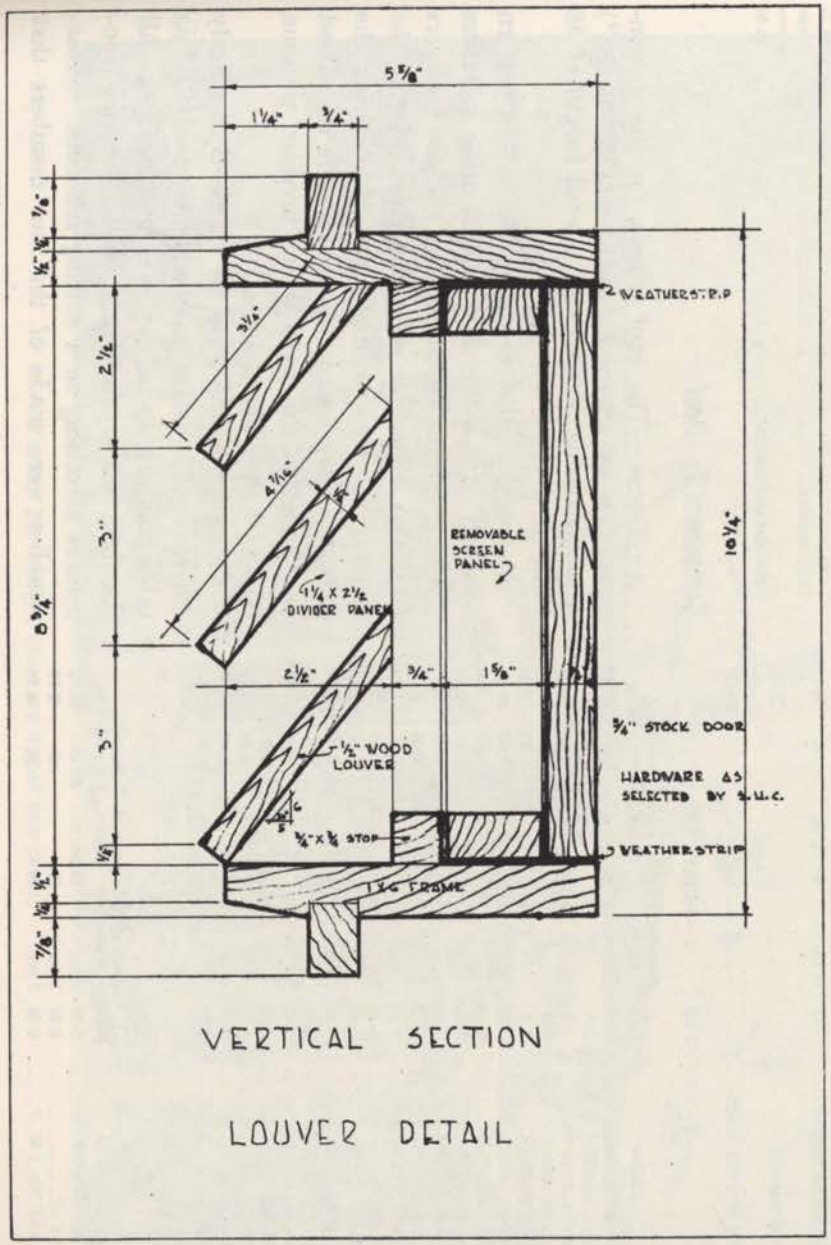


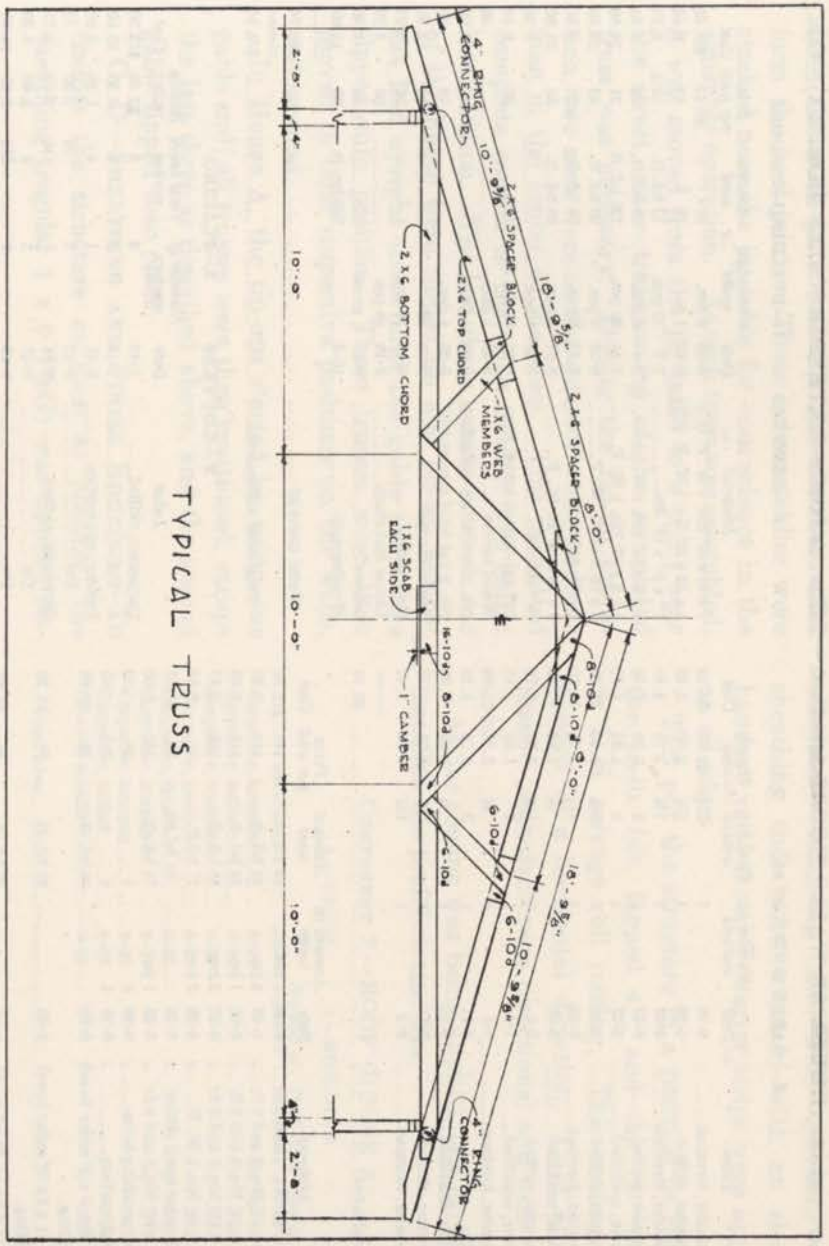
FIGURE 18.



VERTICAL SECTION

LOUVER DETAIL

FIGURE 19.



TYPICAL TRUSS

FIGURE 20.

E.—GABLE END TOTAL

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	6-26	1	2¼	$2.75	$6.19
Carpenter, skilled	6-26	1	2¼	2.50	5.63
Carpenter, foreman	6-27	1	1¾	2.75	4.81
Carpenter, skilled	6-27	2	3	2.50	7.50
Laborer, unskilled	6-27	4	2	1.85	3.70
Carpenter, skilled	6-30	3	15¾	2.50	39.38
Carpenter, foreman	6-30	1	4¼	2.75	11.69
Laborer, unskilled	6-30	1	½	1.85	.93
Carpenter, skilled	7-1	3	1½	2.50	3.75
Laborer, unskilled	7-1	1	1	1.85	1.85
Carpenter, foreman	7-1	1	¼	2.75	.69
Do	7-11	1	2	2.75	5.50
Laborer, unskilled	7-11	1	½	1.85	.93
Carpenter, skilled	7-11	1	1½	2.50	.75
Carpenter, foreman	9-3	1	1¼	2.75	3.44
Total labor					99.74

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 6 x 20′ No. 1 and 2 fir	6-26	4 pcs.	80 bd.-ft.	$0.145	$11.60
2 x 6 x 16′ No. 1 and 2 fir	6-26	4 pcs.	64 bd.-ft.	.145	9.28
2 x 6 x 14′ No. 1 and 2 fir	6-26	1 pc.	14 bd.-ft.	.145	2.03
2 x 4 x 12′ No. 1 and 2 fir	6-26	2 pcs.	16 bd.-ft.	.145	2.32
1 x 4 x 16′ No. 1 W. P.	6-26	2 pcs.	11 bd-ft.	.24	2.64
¾ x 8 cedar bevel siding	6-26		184 bd.-ft.	.28	51.52
2 x 8 x 16′ No. 1 and 2 fir	6-25	1 pc.	21 bd.-ft.	.145	3.05
½ x 4″ machine bolts	6-26	4	4	.08	.32
½″ flat washers	6-26	4	4	.015	.05
Bdl. ¾ x 8 x 9′ cedar bevel siding.	6-30		36 bd.-ft.	.28	10.08
Bdl. ¾ x 8 x 10′ cedar bevel siding.	6-30		40 bd.-ft.	.28	11.20
Bdl. ¾ x 8 x 14′ cedar bevel siding.	6-30		56 bd.-ft.	.28	15.68
Galvanized flashings	7-2		20 lin. ft.		1.96
24″ galvanized screenwire	9-2	24 lin. ft.	48 sq. ft.	.09	4.32
Total material					126.05
Total labor and material					225.79

F.—LOUVERS 1.—BUILDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-8	1	1½	$2.75	$4.12
Laborer, unskilled	7-8	1	¼	1.85	.46
Carpenter, foreman	7-9	1	3¼	2.75	8.94
Carpenter, skilled	7-9	2	7¾	2.50	19.38
Laborer, unskilled	7-9	1	½	1.85	.93
Carpenter, skilled	7-10	3	11½	2.50	28.75
Laborer, unskilled	7-10	1	½	1.85	.93
Carpenter, skilled	7-11	2	4½	2.50	11.25
Laborer, unskilled	7-11	1	¾	1.85	1.39
Carpenter, skilled	8-22	1	¾	2.60	1.95
Carpenter, apprentice	8-22	1	1¼	1.50	1.88
Carpenter, foreman	8-25	1	3½	2.85	9.98
Carpenter, skilled	8-25	1	4¾	2.60	12.35
Carpenter, foreman	8-26	1	6	2.85	17.10
Laborer, unskilled	8-26	1	1	1.50	1.50
Carpenter, foreman	8-27	1	3¼	2.85	9.26
Carpenter, skilled	8-28	1	1½	2.60	3.90
Do	9-2	1	8	2.60	20.80
Do	9-18	2	1½	2.60	3.90
Do	10-14	1	8	2.60	20.80
Total labor					179.57

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 8′ C. W. P.	6-21	4 pcs.	16 bd. ft.	$0.42	$6.72
¾ x 6 x 10′	6-21	1 pc.	6¾	.45	2.70
1 x 6 x 12′ No. 1 W. P.	6-24	6 pcs.	36	.24	8.64

F.—LOUVERS 1.—BUILDING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 10 x 10′ No. 1 W. P. (C)	6-30	6 pcs.	50	$0.42	$21.00
1 x 12 x 12′ No. 1 W. P. (C)	6-30	1 pc.	12	.42	5.04
1″ x 6″ x 12′ Std.	7-7	12 pcs.	72 bd. ft.	.13½	9.72
1 x 6 x 12′ No. 1 W. pine	7-9	6 pcs.	36 bd. ft.	.24	8.64
1 x 6 x 12′ No. 1 W. P.	7-14	20 pcs.	120 bd. ft.	.24	28.80
1 x 10 x 12′ C. W. P.	6-24	9 pcs.	90 bd. ft.	.42	39.80
1 x 6 x 12′ No. 1 W. P.	8-22	6 pcs.	36 bd. ft.	.24	8.64
1 x 10 x 12′ D. W. P.	8-22	6 pcs.	60 bd. ft.	.35	21.00
¼″ staples	8-25	1 box			3.00
24″ galvanized screen wire	8-25	36 lin. ft.	72	.09	6.48
Wood screws	8-26	1 doz.			.08
No. 1583 CM 1½–¾″ offset	8-26	4 pr.			1.00
No. 8 flat head screws 1½″	8-26	4 doz.		.15	.60
Bullet catches	8-28	36		.10	3.60
Cup hooks	9-19	75 pcs.		.02	1.50
Linear feet chain	9-19	38 pcs.		.06	2.28
Screws	9-19	1 gross		1.50	1.50
Weatherstrip	10-2		200 lin. ft.	.05	10.00
Total material					190.74
Total labor and material					370.31

F.—LOUVERS 2.—PLACING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-10	3	5	$2.50	$12.50
Do	7-11	2	4	2.50	10.00
Painter, apprentice	8-11	1	4	1.50	6.00
Do	8-12	1	½	1.50	.75
Carpenter, skilled	8-14	1	1½	2.50	3.75
Do	8-27	1	2	2.60	5.20
Do	8-29	1	5¾	2.60	14.95
Do	9-3	1	2	2.60	5.20
Total labor					58.35
Total material					None
Total labor and material					58.35

Component 7.—Roof

A—TRUSS.—The roof trusses for the demonstration houses were a low pitch (3½″ in 12″) truss, spanning 30′ with an overall length of 36 feet.

To construct the trusses for House A, a pattern was laid out on the slab and all other members precut according to the pattern. These members were also drilled for ring connectors prior to the starting of the assembly procedure. Using the slab as a work space, the trusses were assembled and hung on the walls in an inverted position ready for the tipping operation.

To construct the truss for House B, a slightly different and better method was used. A jig table was set up in the yard of House A. All members were precut and bored for ring connectors according to a cutting schedule. Subassemblies were made of the four members that

form the peak joint and the two members that form the heel joints. These subassemblies were stacked near the jig table for convenience in the assembly operation. As each truss was assembled, it was moved from the jig table to a point near the street, since transporting of the completed truss was necessary. During the tip-up operation, two men were on the exterior walls, and one man in the center of the truss. This permitted complete control of the truss until it was nailed into position. The last three trusses on each end of the house were tipped up and placed against the last upright truss until the gable ends were tipped into position. These trusses were then moved to their respective positions on the walls, and secured.

In House A, the tip-ups started by using one gable end; all trusses were then positioned, except the last three as described above, and the second gable tipped into place.

C, D—Sheathing and Finish Roofing.—To enclose the structure as soon as possible, the sheathing (regular 1 x 6 T&G) was applied immediately following the truss erection. The sheathing ends were trimmed with an electric handsaw, and metal T starter strips were applied on all edges.

This put the structure in a position to receive the 15-lb. felt, lapped 4″, and the 19″ 60-lb. S. I. S. selvage roll roofing. This roofing was applied in a horizontal direction. Cold applied mastic (manufacturer's directions) and nails were used.

As the roofing was being applied, one carpenter installed the prefabricated flue.

Component 7.—ROOF (HOUSE A)

A.—TRUSS 1.—BUILDING

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, foreman	6-26	1	3¾	$2.75	$10.31
Carpenter, skilled	6-26	4	9½	2.50	23.75
Carpenter, unskilled	6-26	1	½	1.75	.88
Carpenter, foreman	6-27	1	4	2.75	11.00
Carpenter, skilled	6-27	3	11¾	2.50	29.38
Carpenter, unskilled	6-27	1	¼	1.75	.44
Carpenter, foreman	6-30	1	2	2.75	5.50
Carpenter, skilled	6-30	1	2	2.50	5.00
Laborer, unskilled	6-30	1	½	1.85	.93
Total labor					87.19

Figure 21.—*Roof trusses are tipped into place.*

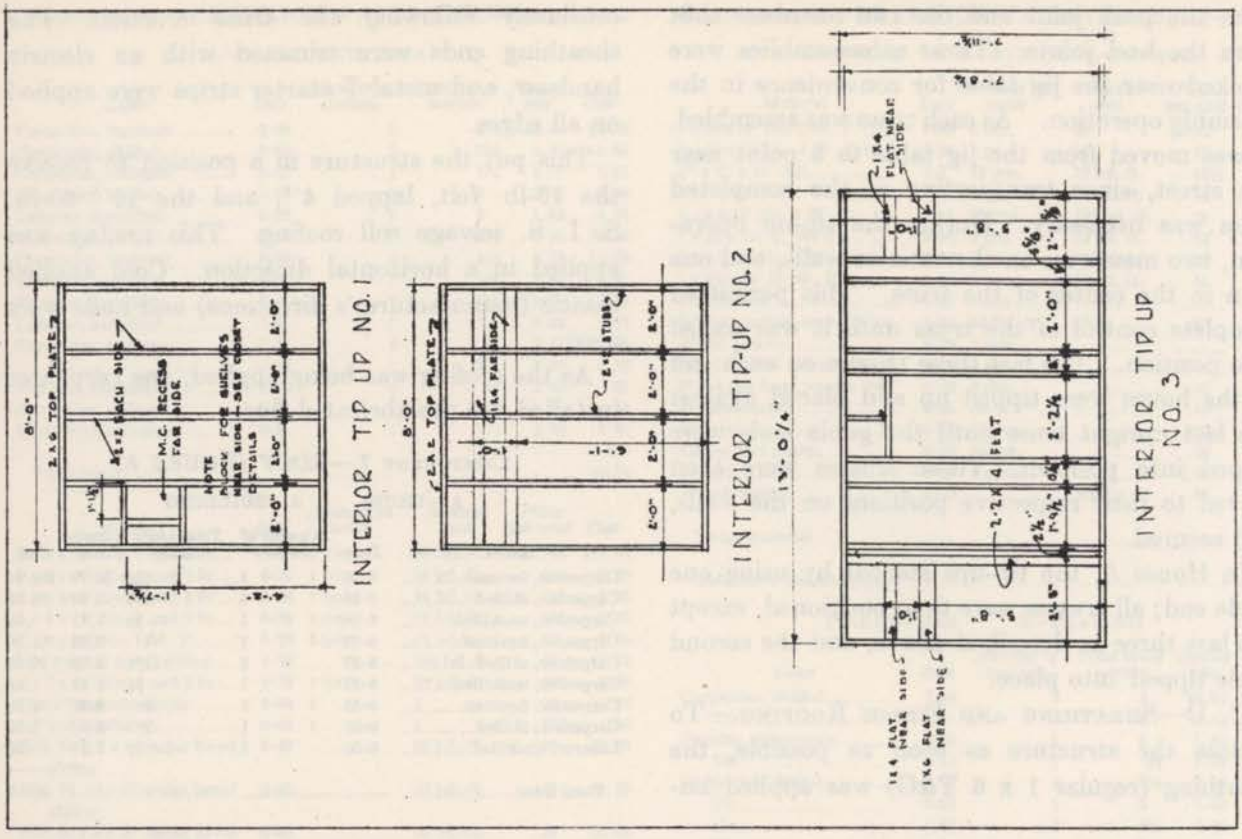


FIGURE 23.

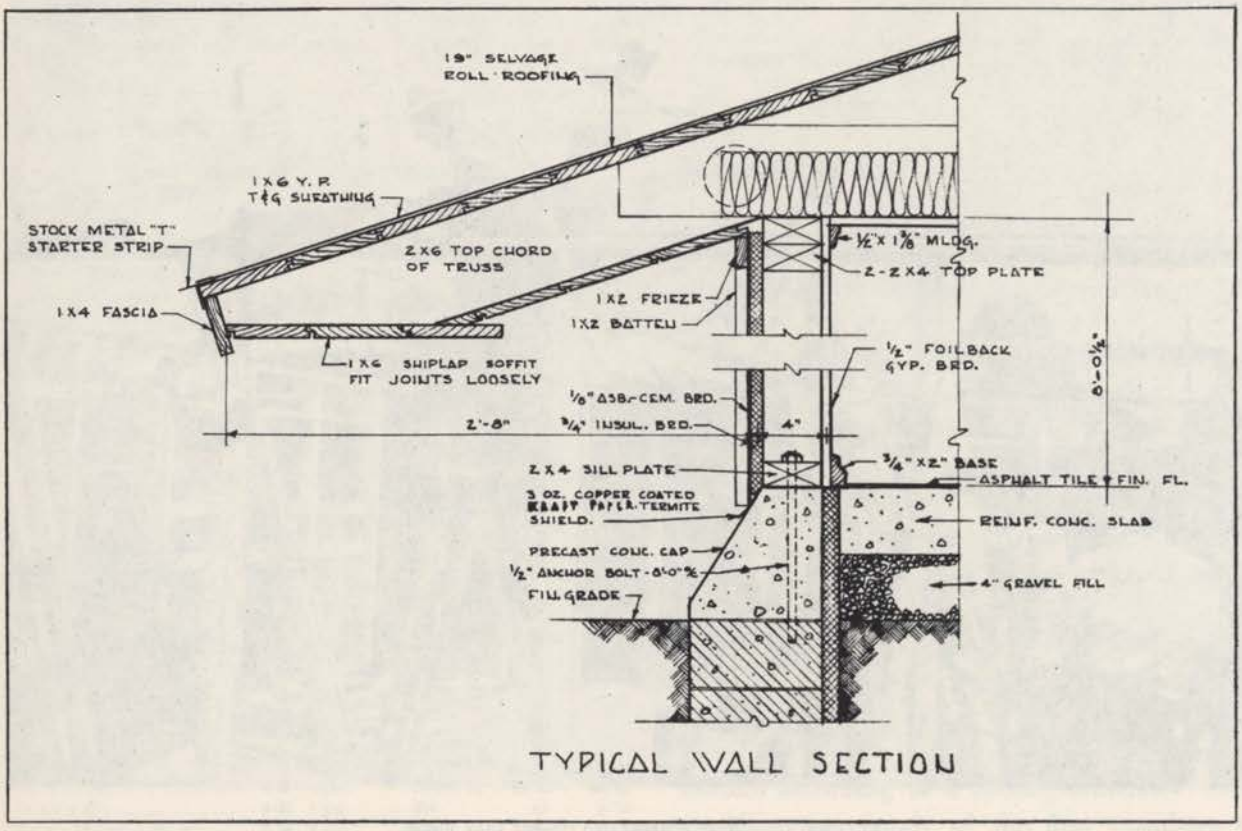


FIGURE 22.

COMPONENT 7.—ROOF (HOUSE A)—Continued

A.—TRUSS 2.—BUILDING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
½ x 4" machine bolts	6-26	32	32	$0.08	$2.56
½" flat washers	6-26	32	32	.01¼	.40
2 x 6 x 20'—No. 1 and 2 fir	6-26	32	640 bd. ft.	.14½	92.80
2 x 6 x 16'—No. 1 and 2 fir	6-26	32	512 bd. ft.	.14½	74.24
2 x 6 x 14'—No. 1 and 2 fir	6-26	1	14 bd. ft.	.14½	2.03
1 x 6 x 14'—std	6-26	8	56 bd. ft.	.13½	7.56
1 x 6 x 10'—std	6-26	32	160	.13½	21.60
Teco 4" ring connectors	6-26	32	32	.18	5.76
½" x 7½" machine bolts	6-26	16	16	.15	2.40
Total material					209.35
Total labor and material					296.54

A.—TRUSS 2.—PLACING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-27	2	2	$2.50	$5.00
Carpenter, unskilled	6-27	1	¼	1.75	.44
Carpenter, foreman	6-27	1	¾	2.75	2.06
Laborer, unskilled	6-27	1	¾	1.85	1.39
Carpenter, foreman	6-30	1	1	2.75	2.75
Carpenter, skilled	6-30	1	1	2.50	2.50
Laborer, unskilled	6-30	1	½	1.85	.93
Carpenter, foreman	7-1	1	1¼	2.75	3.44
Carpenter, skilled	7-1	4	1¾	2.50	4.38
Do	7-8	2	7	2.50	17.50
Carpenter, foreman	7-17	1	½	2.75	1.38
Total labor					41.77
Total material					none
Total labor and material					41.77

C.—SHEATHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-1	1	3¼	$2.75	$8.94
Carpenter, skilled	7-1	4	6¾	2.50	16.88
Carpenter, unskilled	7-1	1	¼	1.75	.44
Laborer, unskilled	7-1	1	5	1.85	9.25
Carpenter, foreman	7-2	1	3¼	2.75	8.94
Carpenter, skilled	7-2	3	10¼	2.50	25.63
Laborer, unskilled	7-2	1	3¼	1.85	6.01
Total labor					76.09

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12' T. and G. Y. P.	6-30	252 pcs.	1,512 bd. ft.	$0.13½	$204.12
1 x 6 x 10' T. and G. Y. P.	7-2	13 pcs.	65 bd. ft.	.13½	8.78
Total material					212.90
Total labor and material					288.99

D.—SHINGLES (INCLUDING STARTER STRIPS)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-1	2	1	$2.50	$2.50
Do	7-2	4	6¾	2.50	16.88
Laborer, unskilled	7-2	1	1¾	1.85	3.24
Carpenter, foreman	7-3	1	3¼	2.75	8.94
Carpenter, skilled	7-3	2	6½	2.50	16.25
Carpenter, foreman	7-7	1	4½	2.75	12.38
Carpenter, skilled	7-7	2	9	2.50	22.50
Laborer, unskilled	7-7	1	4½	1.85	8.33
Carpenter, skilled	7-15	2	4	2.50	10.00
Carpenter, foreman	7-15	1	2	2.75	5.50
Carpenter, skilled	7-16	2	5	2.50	12.50
Laborer, unskilled	7-18	1	¼	1.85	.46
Total labor					119.48

COMPONENT 7.—ROOF (HOUSE A)—Continued

D.—SHINGLES (INCLUDING STARTER STRIPS)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
15# felt	6-27	4 rolls	4 rolls	$3.70	$14.80
19" selvage edge roofing, black.	6-27	25 rolls	25 rolls	2.85	71.25
Ft. "T" starter strip 14/10	6-27	140 lin. ft.	140	.09	12.60
Black plastic	6-27	5—5-gal. cans.	25 gals.	3.60	18.00
⅞" galvanized roofing nails	7-7	50# carton			9.00
Tin caps	7-3	20#	20#	.24	4.80
1 length 10' D starter strip	7-2		10	.09	.90
10# tin caps	7-1	10#	10#	.24	2.40
19" selvage edge roofing, black.	7-15	6 rolls	60 rolls	2.85	17.10
Black plastic roofing cement.	7-15	3-5 gal. cans.	15 gals.	.72	10.80
Total material					161.65
Total labor and material					281.13

Component 8.—Exterior Trim

As mentioned several times in this report, working from scaffolding was eliminated. It was necessary, however, to do something to elevate the workman. In this case, ladders and run boards were used since the operation was of very short duration.

In the sequence of assembly for the house, this operation followed the roofing operation and was completed by two members of the crew while the others were installing the exterior door frames and combination doors.

COMPONENT 8.—EXTERIOR TRIM (HOUSE A)

A.—SOFFIT

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-11	2	7½	$2.50	$18.75
Laborer, unskilled	7-11	1	½	1.85	.93
Carpenter, skilled	7-14	2	2	2.50	5.00
Total labor					24.68

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 8 x 12' std. shiplap	7-10	22 pcs.	176 bd. ft.	$0.135	$23.76
1 x 8 x 14' std. shiplap	7-14	12 pcs.	112 bd. ft.	.135	15.12
¾" quarter round	7-16	68	68 lin. ft.	.04	2.72
Total material					41.6
Total labor and material					66.28

B.—FASCIA

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-1	2	1½	$2.50	$3.75
Do	7-2	2	1½	2.50	3.75
Total labor					7.50

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12' C. fir	7-1	6 pcs.	36 bd. ft.	$0.34	$12.24
Total material	7-1	6 pcs.	36 bd. ft.	$0.34	12.24
Total labor and material					19.74

COMPONENT 8.—EXTERIOR TRIM (HOUSE A)—Con.

C.—RAKE AND FREIZE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-1	2	1	$2.50	$2.50
Do	7-2	2	2½	2.50	6.25
Total labor					8.75

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 4 x 20' C. fir	6-30	4 pcs.	27 bd. ft.	$0.34	$9.18
1 x 6 x 16' No. 1 W. P	6-20	6 pcs.	48 bd. ft.	.24	11.52
Total material					20.70
Total labor and material					29.45

Component 9.—Partitions

The partitions were constructed in the same way as the exterior wall sections, the subfloor being used as a work space. These sections were constructed from precut material and were tipped into place and nailed.

The plumbing wall was designated as wall No. 1 and was constructed by using top and bottom plates of 2 x 6's. These members were notched to allow for the vent stack. The 2 x 2 studs were applied on one side only before erection. The other 2 x 2's were fitted and toe-nailed after the partition was in the upright position.

All other partitions were built in sequence. In all cases, this sequence allowed for adequate work space close to where the partition was to be erected. It also allowed for adequate nailing from one partition to the other.

COMPONENT 9.—PARTITIONS (HOUSE A)

A.—ALL FRAMING (INCLUDES ALL OPENINGS)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-17	1	4	$2.75	$11.00
Carpenter, skilled	7-17	4	6¾	2.50	16.88
Laborer, unskilled	7-17	1	2¼	1.85	4.16
Carpenter, foreman	7-18	1	3	2.75	8.25
Carpenter, skilled	7-18	2	8	2.50	20.00
Laborer, unskilled	7-18	1	¾	1.85	1.39
Carpenter, foreman	7-21	1	¾	2.75	2.06
Carpenter, skilled	7-22	3	4¾	2.50	11.88
Carpenter, foreman	7-25	1	½	2.75	1.38
Carpenter, skilled	8-13	1	2¼	2.50	5.63
Total labor					82.63

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 6 x 16' No. 1 and 2 fir	7-16	1 pc.	16 bd. ft.	$0.145	$2.32
2 x 4 x 16' No. 1 and 2 fir	7-16	25 pcs.	267 bd. ft.	.145	38.72
2 x 4 x 14' No. 1 and 2 fir	7-16	4 pcs.	37 bd. ft.	.145	5.36
2 x 4 x 12' No. 1 and 2 fir	7-16	2 pcs.	16 bd. ft.	.145	2.32
2 x 4 x 18' No. 1 and 2 fir	7-22	3 pcs.	36 bd. ft.	.145	5.22
2 x 4 x 12' No. 1 and 2 fir	8-13	1 pc.	8 bd. ft.	.145	1.16
2 x 4 x 12' No. 1 and 2 fir	8-13	2 pcs.	16 bd. ft.	.145	2.32
Total material					57.42
Total labor and material					140.05

Component 10.—Windows

Since the exterior walls were completed on the slab before erection, the fixed glass could be set anytime after the wall was in place and securely fastened. This, however, was not done until the roof section had been completed and the danger of falling objects eliminated.

This was a subcontract operation that required very little time and did not interfere with the carpentry crew. The work was done when the carpenters were putting on the combination doors. This enclosed the house from the weather.

COMPONENT 10.—WINDOWS (HOUSE A)

A.—SILLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-23	1	1¾	$2.50	$4.39
Carpenter, unskilled	6-23	1	3¾	1.75	6.57
Carpenter, foreman	6-24	1	1½	2.75	4.12
Carpenter, skilled	6-24	1	1½	2.50	3.75
Carpenter, foreman	6-25	1	¾	2.75	2.06
Carpenter, skilled	6-26	2	½	2.50	1.25
Total labor					22.14

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12'—0"— 1 and 2 fir	6-24	8 pcs.	64 bd. ft.	$0.145	$9.28
Total material					9.28
Total labor and material					31.42

D.—SETTING FIXED GLASS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-15	3	3½	$2.50	$8.75
Subcontract:					
Glazier, skilled	7-16	1	½	------	------
Glazier, apprentice	7-16	1	½	------	------
Glazier, skilled	7-16	1	1	------	------
Glazier, apprentice	7-16	1	1	------	------
Total labor					8.75

Material	Date	Amount in units	Amount used	Price per unit	Cost
Material and labor for setting fixed glass 4-7/32 x 80 x 46 crystal, 7 D. S. B. 12 x 46, 3 D. S. B. 28 x 46, 3-7/32 x 42 x 46 crystal, 3 D. S. B. 51½ x 46.					$157.68
Total material					157.68
Total labor and material					166.43

E.—TRIM

O.—PRECUTTING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	6-21	1	¾	$2.50	$1.89
Carpenter, apprentice	6-21	2	1½	1.75	2.63
Carpenter, skilled	6-23	1	¾	2.50	1.89
Carpenter, apprentice	6-23	1	1¼	1.75	2.19
Total labor					8.60
Total material					None
Total labor and material					8.60

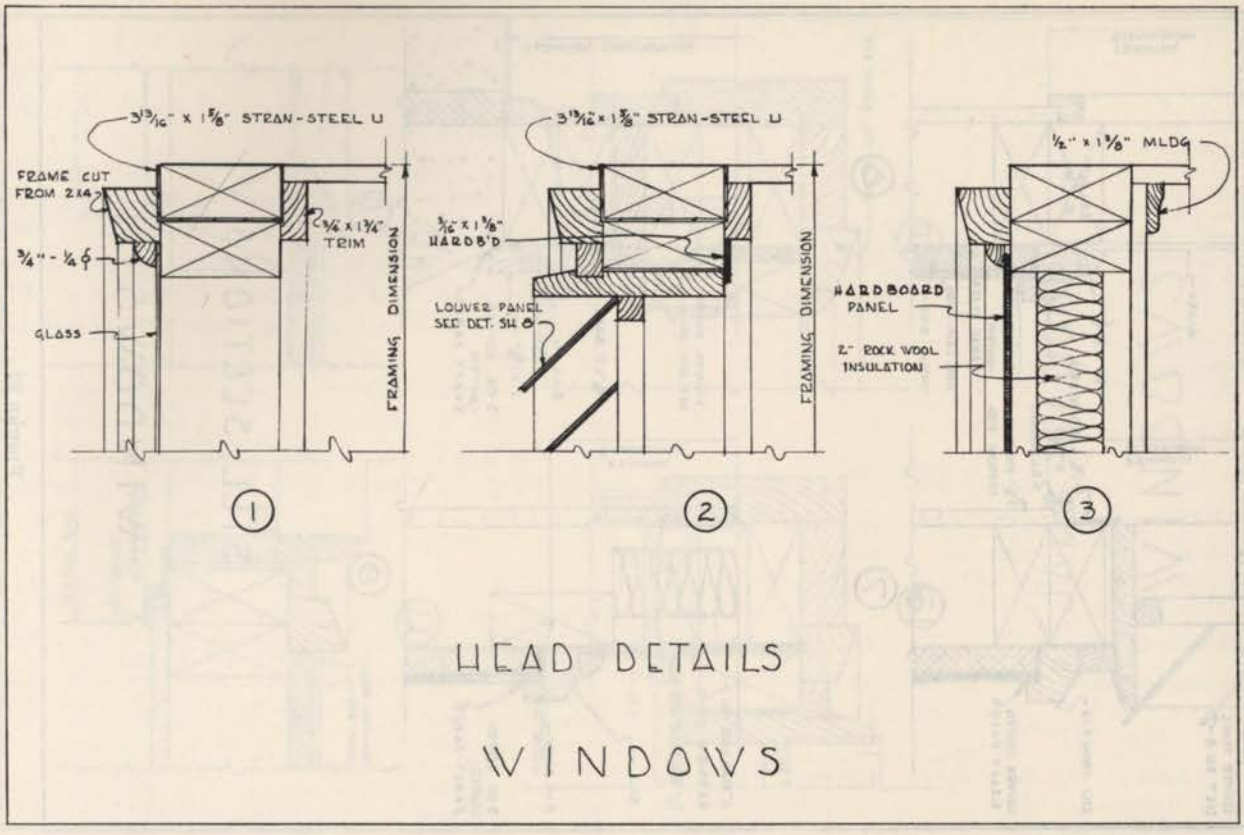


FIGURE 25.

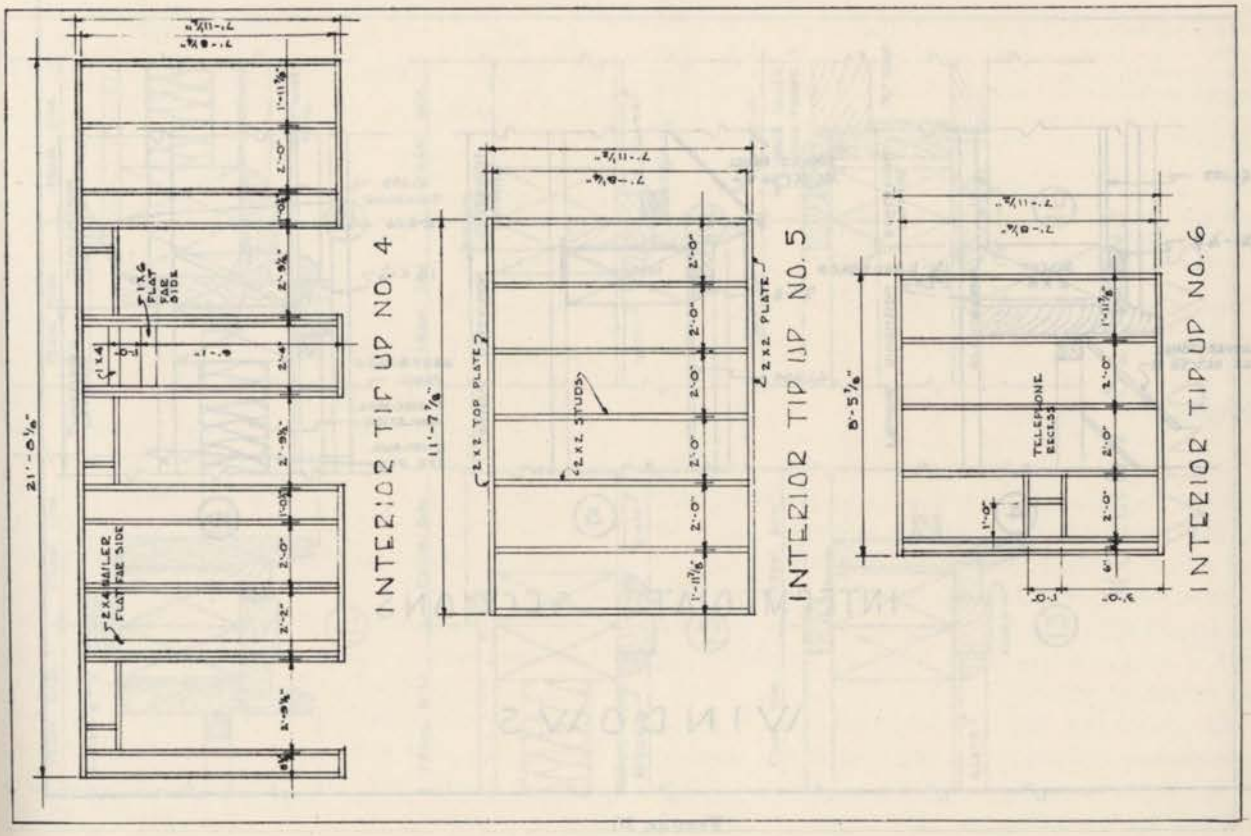


FIGURE 24.

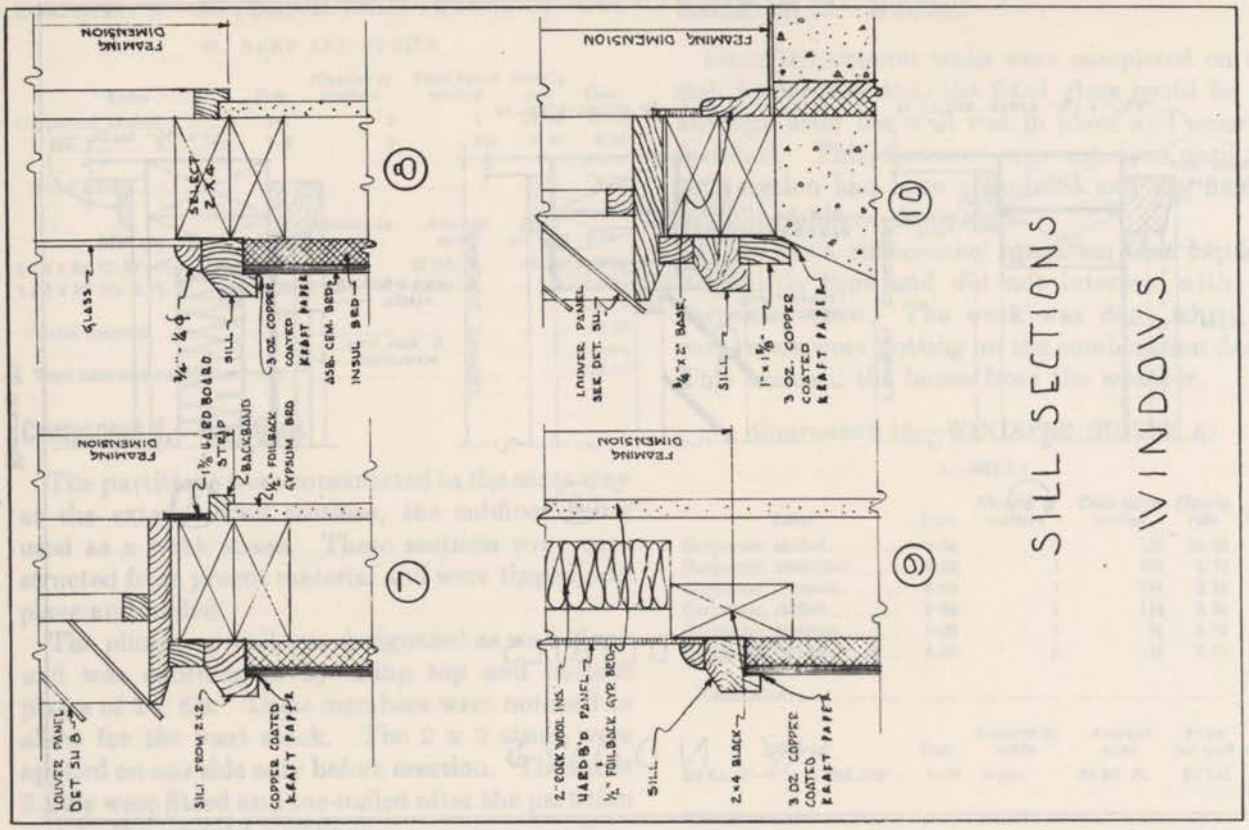


FIGURE 27.

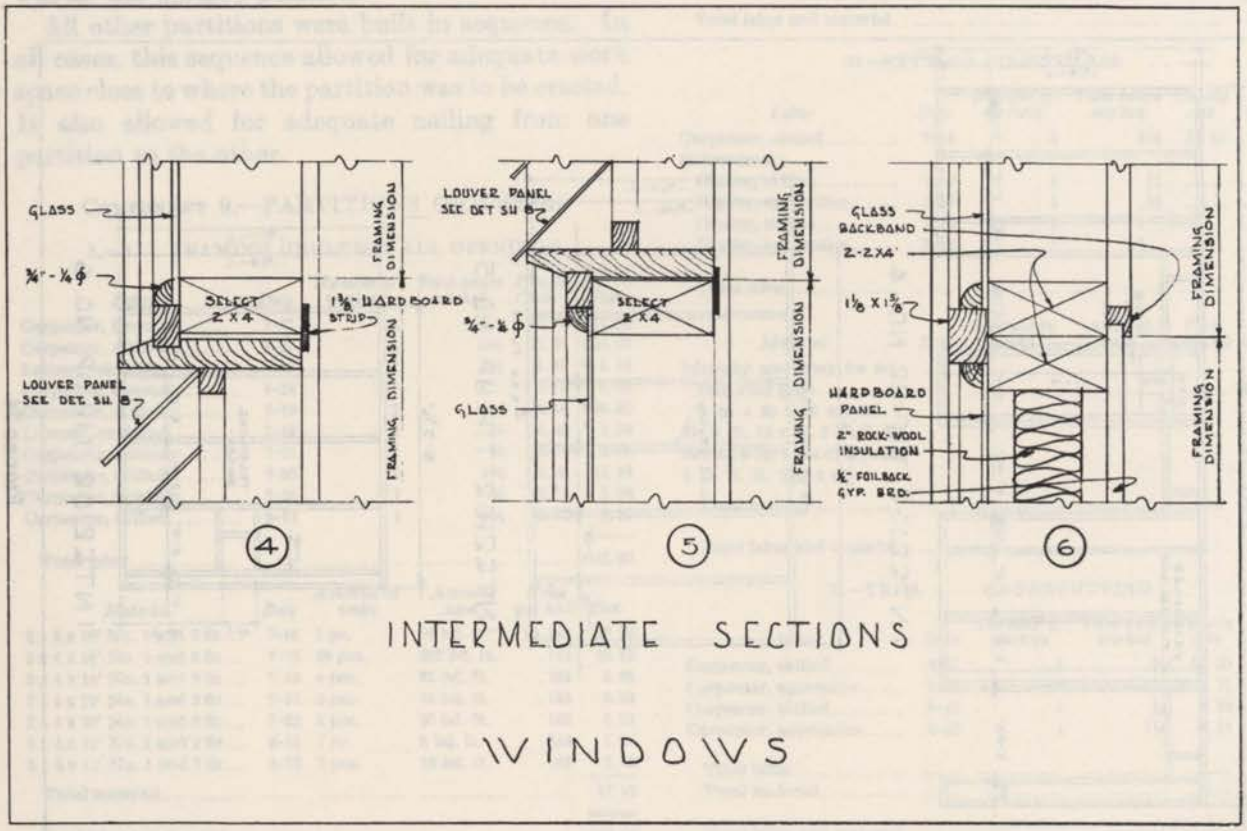


FIGURE 26.

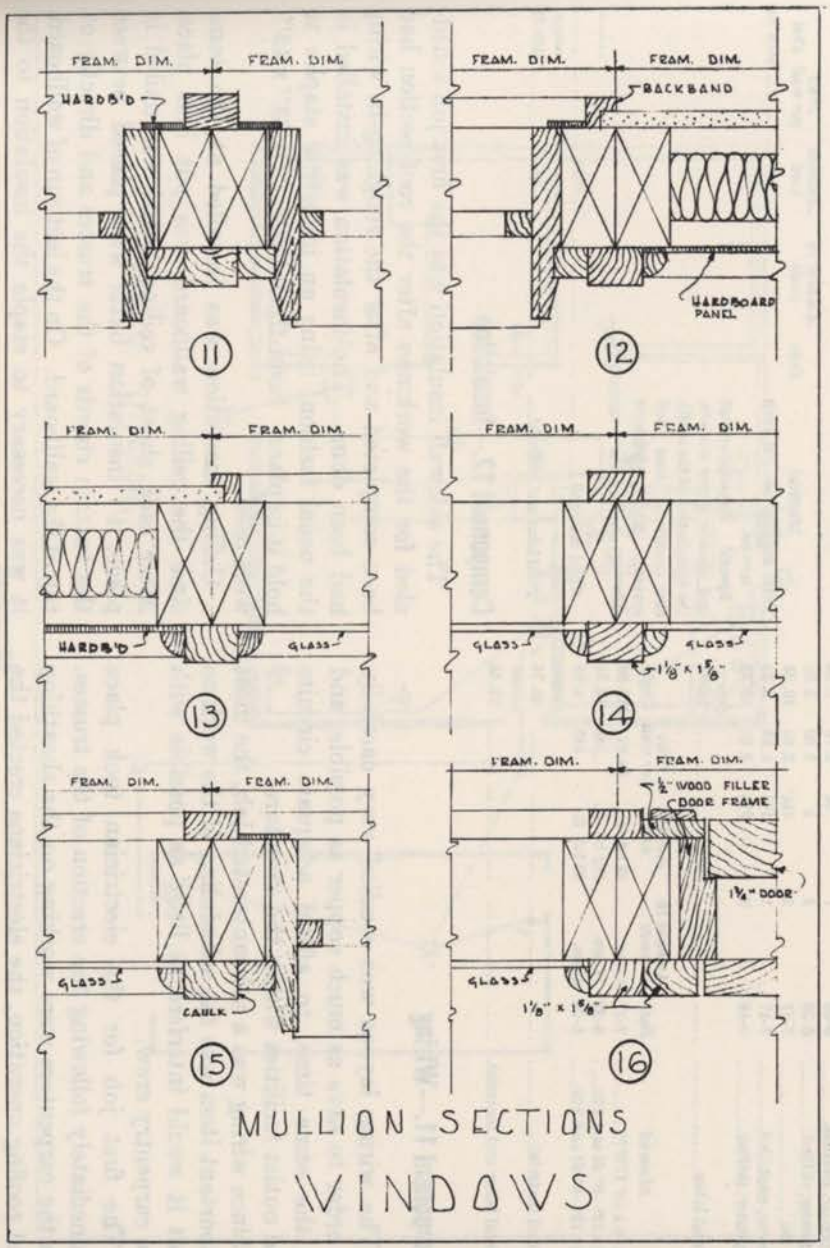


FIGURE 28.

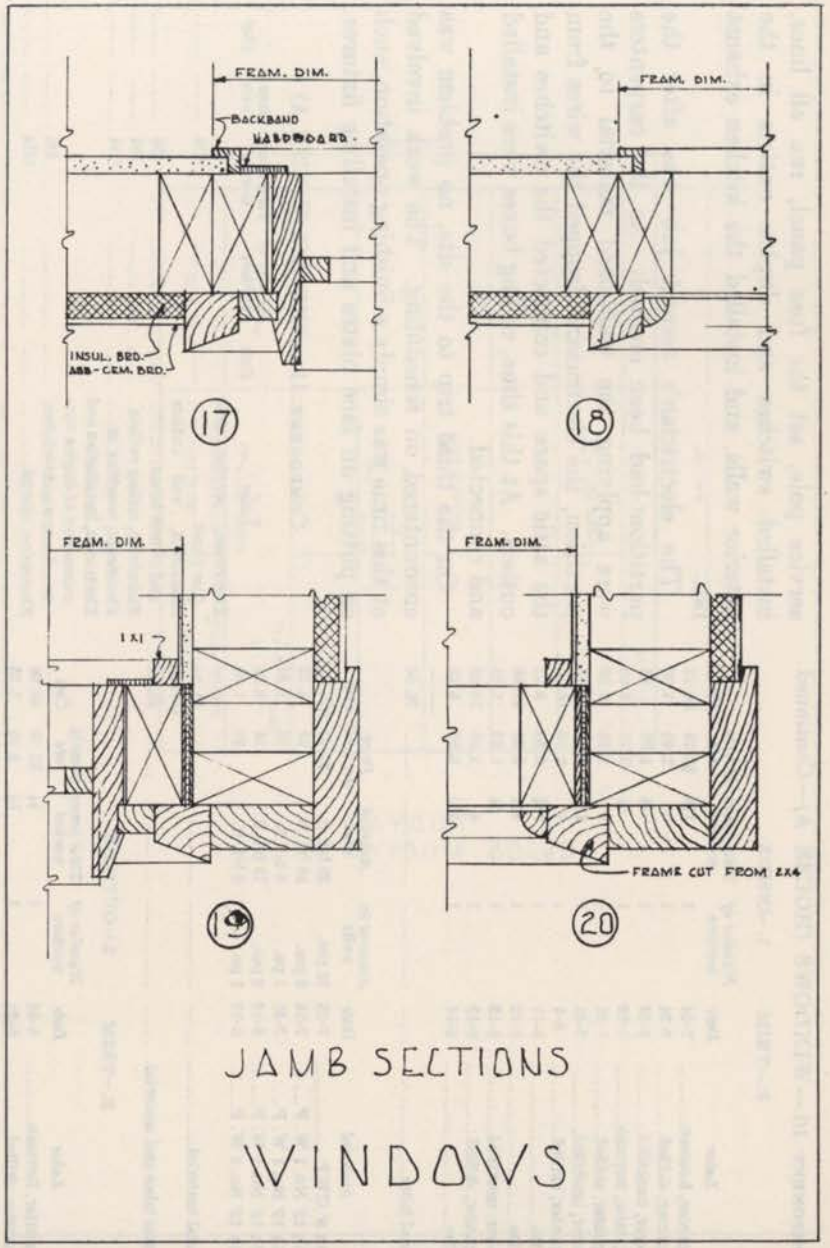


FIGURE 29.

COMPONENT 10.—WINDOWS (HOUSE A)—Continued

E.—TRIM 1.—INSIDE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-24	1	1½	$2.75	$4.12
Carpenter, skilled	7-24	1	2	2.50	5.00
Laborer, unskilled	7-24	1	½	1.85	.93
Carpenter, foreman	7-25	1	¾	2.75	2.06
Carpenter, skilled	7-31	1	4	2.50	10.00
Laborer, unskilled	7-31	1	1½	1.85	2.78
Carpenter, skilled	8-1	1	4	2.50	10.00
Do	8-11	1	1¼	2.50	3.13
Do	8-12	1	4¾	2.50	11.88
Laborer, unskilled	8-12	1	¾	1.85	1.39
Carpenter, skilled	8-13	1	4	2.50	10.00
Do	8-14	1	3½	2.50	8.75
Total labor					70.04

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 8' CWP	7-18	70 pcs.	28 bd. ft.	$0.42	$11.76
1 x 6 x 12' No. 1 W. P	7-24	3 pcs.	18 bd. ft.	.24	4.32
1 x 6 x 12' No. 1 W. P	7-31	1 pc.	6 bd. ft.	.24	1.44
1 x 6 x 12' No. 1 W. P	8-12	2 pcs.	12 bd. ft.	.24	2.88
1 x 6 x 12' No. 1 W. P	8-12	1 pc.	6 bd. ft.	.24	1.44
Total material					21.84
Total labor and material					91.88

E.—TRIM 2.—OUTSIDE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	6-24	1	¼	$2.75	$0.69
Carpenter, skilled	6-24	1	½	2.50	1.25
Carpenter, foreman	6-25	1	1½	2.75	4.12
Carpenter, skilled	6-25	1	2	2.50	5.00
Carpenter, foreman	6-26	1	¾	2.75	2.06
Carpenter, skilled	6-26	2	2	2.50	5.00
Do	7-17	2	4¼	2.50	10.63
Laborer, unskilled	7-17	1	1¾	1.85	3.24
Carpenter, skilled	7-18	2	7½	2.50	18.75
Total labor					50.74

Material	Date	Amount in units	Amount used	Price per unit	Cost
½ x 10 x 10' CWP	7-17	4 pcs.	33 bd. ft.	$0.42	$13.86
2 x 4 x 12'—0" #1 and 2 fir	6-20	14 pcs.	112 bd. ft.	.145	16.24
2 x 4 x 12'—0" #1 and 2 fir	6-24	4 pcs.	32 bd. ft.	.145	4.64
Total material					34.74
Total labor and material					85.48

Component 11.—Wiring

The wiring layout was studied very carefully in order to save as much copper as possible, and at the same time, to afford adequate circuits and outlet facilities within the structure.

Since wiring was a subcontracted job, the most important item was the scheduling of the work so that it would interfere as little as possible with the carpentry crew.

The first job for the electrician took place immediately following the erection of the trusses. As the carpenters were working on the sheathing and roofing operation, the electricians erected the service pole, set the fuse panel, ran all lines, installed switches and duplex outlets in the exterior walls, and installed the kitchen exhaust fan.

The electrician's second job was after the partition had been erected. As the carpenters were applying the wallboard material to the partition, the electricians dropped the wires from the attic space and connected the switches and outlets. At this time, ceiling boxes were installed and connected.

On the third trip to the site, no problem was encountered on scheduling. The work involved at this time was simply a finishing operation, such as putting on face plates and installing fixtures.

COMPONENT 11.—WIRING (HOUSE A)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Electrician, service and fuse panel			8½		
Electrician, wall outlets and switch boxes			2½		
Electrician, ceiling outlets			3¼		
Electrician, roughing in			15¼		
Electrician, installation and connection of duplex outlets, fixtures and switches			5½		
Electrician, special			12½		
Total labor (included in subcontract)					

Material	Date	Amount in units	Amount used	Price per unit	Cost
Total subcontract 100 amp service. Special includes—range and electric dryer outlets, the installation of the medicine cabinet, door bell system, and telephone raceway.					$470.75
Total material					
Total labor and material					470.75

Component 12.—Insulation

The sidewall insulation was the first job scheduled for the workmen after the roof section had been completed and after the roughing-in wiring had been done. The insulation was installed in the usual fashion, using an industrial stapler to hold it in place. Semi-thick batts, 2" x 23" x 48", were used.

Ceiling insulation was installed at the same time the ceiling wallboard was put into place. After each sheet of ceiling board was nailed in place, 4" insulation batts were placed between the bottom chords of the trusses and directly on top of the wallboard. On the last run of wallboard, it was necessary to staple the insulation to the

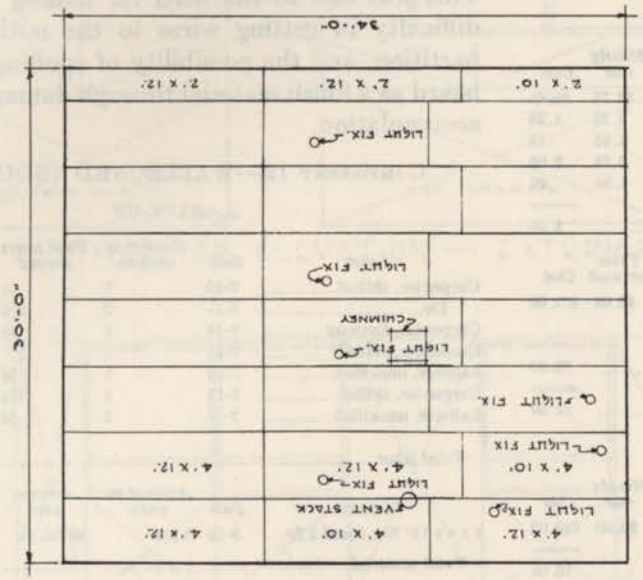


FIGURE 31.

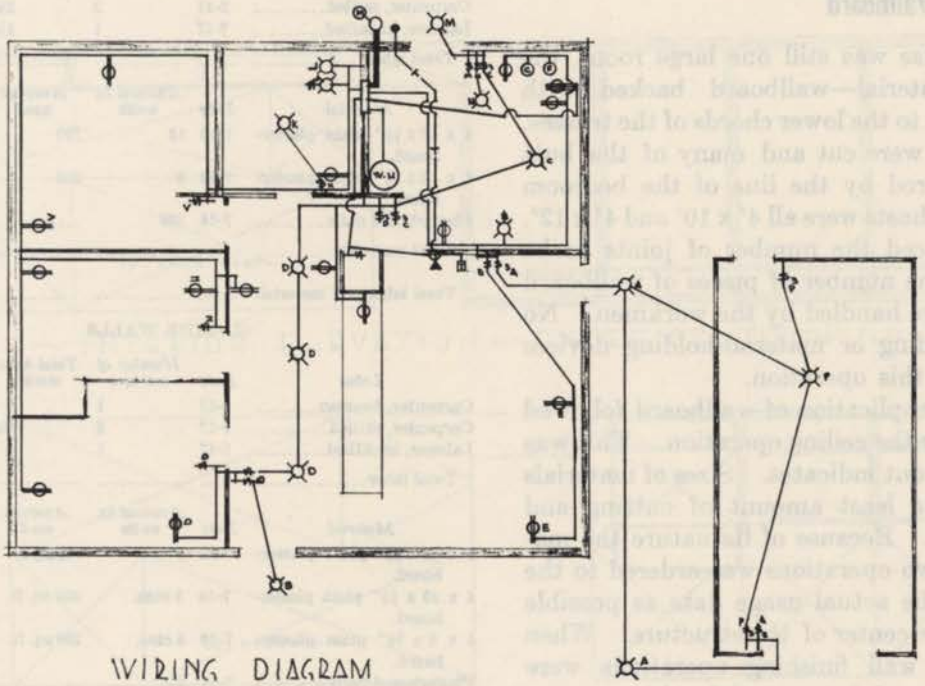


FIGURE 30.

bottom chords before the wallboard was nailed into place.

COMPONENT 12.—INSULATION (HOUSE A)

A.—CEILING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-16	1	¼	$2.75	$0.69
Carpenter, skilled	7-16	2	½	2.50	1.25
Laborer, unskilled	7-16	1	¼	1.85	.46
Carpenter, foreman	7-17	1	¾	2.75	2.06
Laborer, unskilled	8-11	1	½	1.85	.93
Total labor					5.39

Material	Date	Amount in units	Amount used	Price per unit	Cost
12 cartons 23 x 48 full thick rock wool batts.	8-16	920 sq. ft.		$0.08	$73.60
Total material					73.60
Total labor and material					78.99

B.—SIDE WALLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-17	2	4	$2.50	$10.00
Total labor					10.00

Material	Date	Amount in units	Amount used	Price per unit	Cost
23 x 48 semithick rock wool batts.	7-17	9 ctns.	690 sq. ft.	$0.057	$39.33
Total material					39.33
Total labor and material					49.33

Component 13.—Wallboard

While the house was still one large room, the ceiling finish-material—wallboard backed with foil—was applied to the lower chords of the trusses. Only two sheets were cut and many of the butt joints were covered by the line of the bedroom partition. The sheets were all 4′ x 10′ and 4′ x 12′. These sizes reduced the number of joints to be taped and also the number of pieces of wallboard material that were handled by the workmen. No elaborate scaffolding or material-holding devices were needed for this operation.

The side wall application of wallboard followed immediately after the ceiling operation. This was applied as the layout indicates. Sizes of materials that required the least amount of cutting and fitting were used. Because of its nature the material for these two operations was ordered to the job as close to the actual usage date as possible and stored in the center of the structure. When the ceiling and wall finishing operations were completed, the remaining material, which was to be used for the partitions, was moved to one corner of the bedroom section. This material was applied after the partitions had been erected. No attempt was made to apply the wallboard to the partition framing before it was tipped into place. This was due to the need for nailing space, the difficulty in getting wires to the outlets in the partition, and the possibility of spoiling the wallboard as a finish material through damage and dirt accumulation.

COMPONENT 13.—WALLBOARD (HOUSE A)

A.—BACK-UP

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-10	1	½	$2.50	$1.25
Do	7-11	2	2¼	2.50	5.63
Carpenter, foreman	7-16	1	½	2.75	1.38
Carpenter, skilled	7-16	2	1	2.50	2.50
Laborer, unskilled	7-16	1	¼	1.85	.46
Carpenter, skilled	7-17	2	2¼	2.50	5.63
Laborer, unskilled	7-17	1	½	1.85	.93
Total labor					17.78

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12′ No. 1 and 2 fir	8-13	5 pcs	40 bd. ft.	$0.145	$5.80
Total material					5.80
Total labor and material					23.58

B.—CEILING

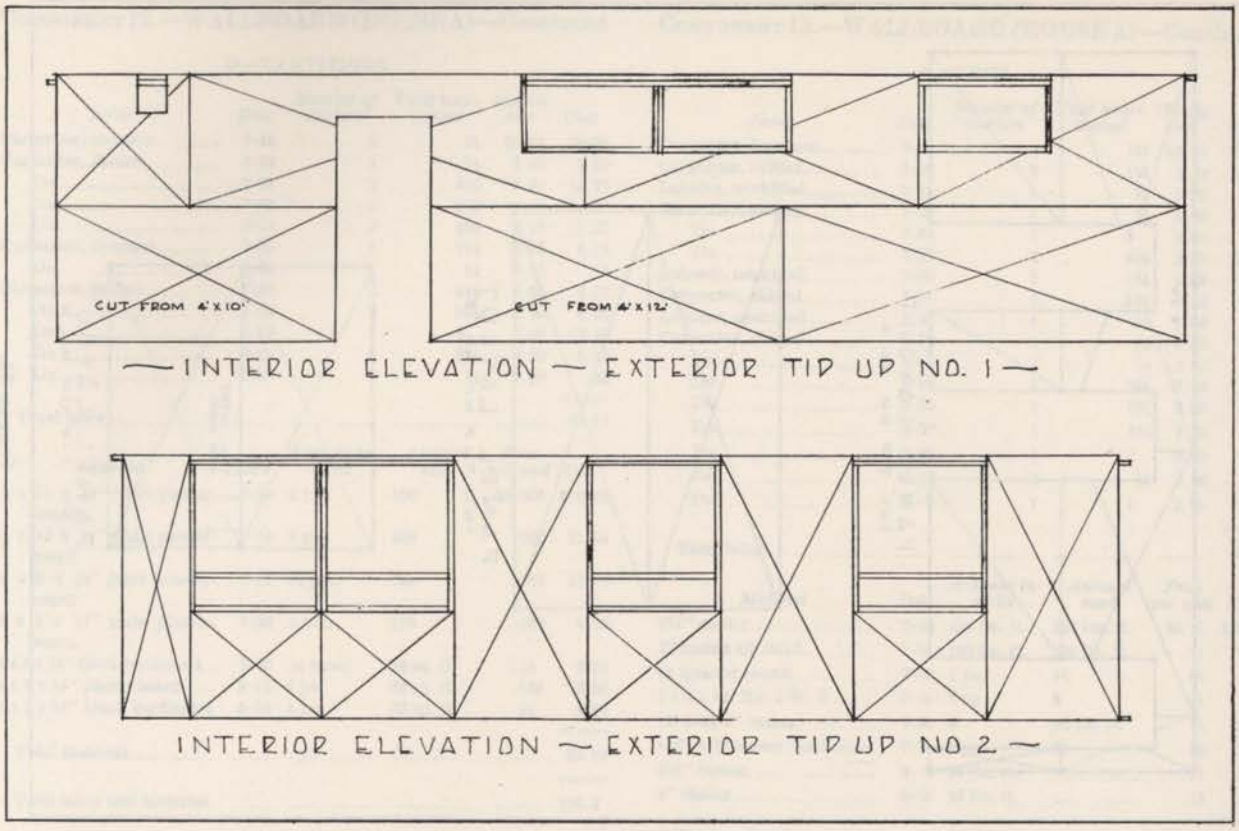
Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-16	1	3	$2.75	$8.25
Carpenter, skilled	7-16	2	5½	2.50	13.75
Laborer, unskilled	7-16	1	3	1.85	5.55
Carpenter, foreman	7-17	1	½	2.75	1.38
Carpenter, skilled	7-17	2	2½	2.50	6.25
Laborer, unskilled	7-17	1	1½	1.85	2.78
Total labor					37.96

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 12 x ½″ plain plasterboard.	7-16	15	720	$0.065	$46.80
4 x 10 x ½″ plain plasterboard.	7-16	8	320	.065	20.80
Plasterboard nails	7-16	25#			3.50
Total material					71.10
Total labor and material					109.06

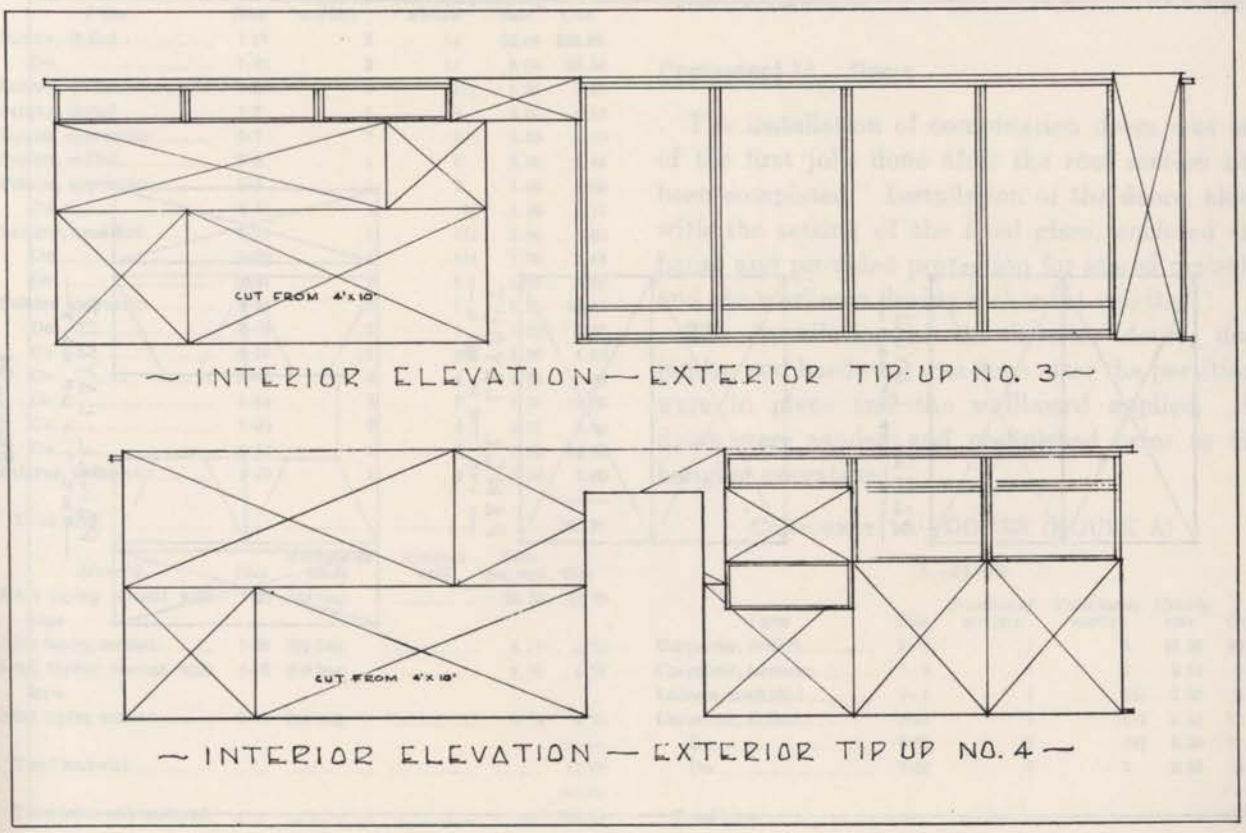
C.—SIDE WALLS

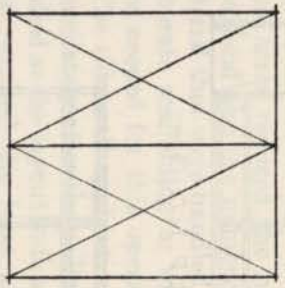
Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-17	1	1	$2.75	$2.75
Carpenter, skilled	7-17	3	10¼	2.50	25.63
Laborer, unskilled	7-17	1	1	1.85	1.85
Total labor					30.23

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 12 x ½″ plain plasterboard.	7-16	3	144 sq. ft.	$0.065	$9.36
4 x 10 x ½″ plain plasterboard.	7-16	8 ctns.	320 sq. ft.	.065	20.80
4 x 8 x ½″ plain plasterboard.	7-16	8 ctns.	256 sq. ft.	.065	16.64
Plasterboard nails	7-16	25#			3.50
Total material					50.30
Total labor and material					80.53

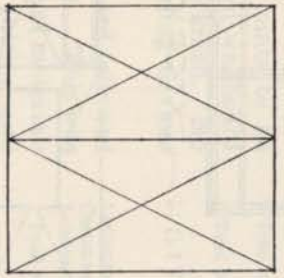


FIGURES 32 *(above) and* 33 *(below).*

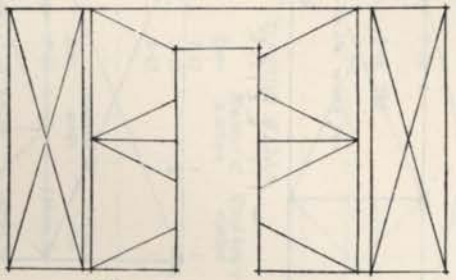




PANEL LAYOUT
—INT. TIP UP NO. 1—

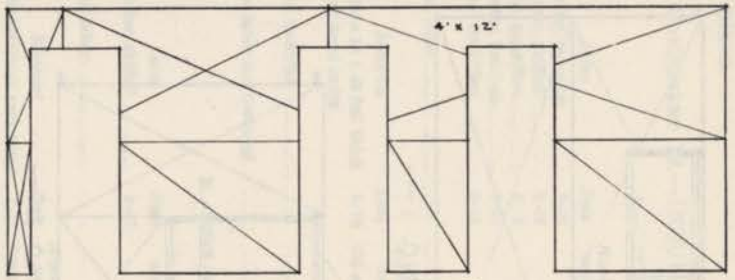


PANEL LAYOUT
— INT. TIP UP NO 2 —

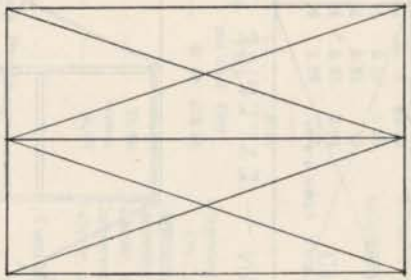


PANEL LAYOUT
—INT. TIP UP NO. 3 —

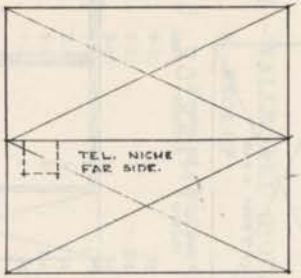
FIGURE 34.



PANEL LAYOUT
INT. TIP UP NO. 4



PANEL LAYOUT
INT. TIP UP NO 5



PANEL LAYOUT
INT TIP UP NO. 6

FIGURE 35.

COMPONENT 13.—WALLBOARD (HOUSE A)—Continued

D.—PARTITIONS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-18	1	¼	$2.75	$0.69
Carpenter, skilled	7-18	2	½	2.50	1.25
Do	7-21	2	5½	2.50	13.75
Do	7-22	3	5¾	2.50	14.38
Do	7-23	3	4½	2.50	11.25
Carpenter, foreman	7-23	1	1½	2.75	4.12
Do	7-24	1	¼	2.75	.69
Carpenter, skilled	7-24	2	3½	2.50	8.75
Do	7-28	2	2¾	2.50	6.88
Do	8-12	1	5	2.50	12.50
Do	8-12	1	2½	2.50	6.25
Do	9-3	1	¼	2.50	.63
Total labor					81.14

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 10 x ½" plain plasterboard.	7-18	4 pcs.	160	$0.065	$10.40
4 x 12 x ½" plain plasterboard.	7-18	7 pcs.	336	.065	21.84
4 x 8 x ½" plain plasterboard.	7-18	22 pcs.	704	.065	45.76
4 x 8 x ½" plain plasterboard.	7-28	4 pcs.	128	.065	8.32
4 x 8 x ⅛" black hardboard	7-30	½ sheet	16 sq. ft.	.14	2.24
4 x 8 x ½" plasterboard	8-12	1 pc.	32 sq. ft.	.065	2.08
4 x 8 x ⅛" black hardboard	8-12	1 pc.	32 sq. ft.	.14	4.48
Total material					95.12
Total labor and material					176.26

E.—TAPING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Painter, skilled	7-19	2	14	$2.00	$28.00
Do	7-20	2	11	2.00	22.00
Laborer, unskilled	7-21	1	1¼	1.85	2.31
Painter, skilled	7-7	1	2	2.00	4.00
Painter, apprentice	8-7	1	2	1.50	3.00
Painter, skilled	8-8	1	2	2.00	4.00
Painter, apprentice	8-8	1	2	1.50	3.00
Do	8-11	1	¾	1.50	1.13
Laborer, unskilled	8-19	1	3¾	1.50	5.63
Do	8-20	1	5¼	1.50	7.88
Do	8-21	1	5	1.50	7.50
Painter, apprentice	8-14	2	7	1.50	10.50
Do	8-15	2	4	1.50	6.00
Do	8-16	1	3¼	1.50	4.88
Do	8-18	2	4	1.50	6.00
Do	8-19	2	7	1.50	10.50
Do	8-20	2	5	1.50	7.50
Do	8-17	1	8	1.50	12.00
Laborer, unskilled	8-27	1	2	1.50	3.00
Total labor					148.83

Material	Date	Amount in units	Amount used	Price per unit	Cost
Joint taping cement with tape.	7-25	25# bag		$4.75	$4.75
Joint taping cement	7-25	25# bag		3.75	3.75
Joint taping cement with tape.	7-25	25# bag		4.75	4.75
Joint taping cement	8-11	25# bag		3.75	3.75
Total material					17.00
Total labor and material					165.83

COMPONENT 13.—WALLBOARD (HOUSE A)—Continued

F.—TRIM

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-24	1	1¼	$2.75	$3.44
Carpenter, skilled	7-24	2	1¼	2.50	3.13
Laborer, unskilled	7-24	1	¼	1.85	.46
Carpenter, skilled	7-28	1	¼	2.50	.63
Do	7-29	1	3	2.50	7.50
Do	7-30	2	9½	2.50	23.75
Laborer, unskilled	7-30	1	1¾	1.85	3.24
Carpenter, skilled	7-31	1	3¾	2.50	9.38
Laborer, unskilled	7-31	1	¼	1.85	.46
Carpenter, skilled	8-13	1	½	2.50	1.25
Do	8-14	1	½	2.50	1.25
Do	8-19	1	2¼	2.50	5.63
Do	8-26	1	1¾	2.60	4.55
Do	8-27	1	1¾	2.60	4.55
Do	8-28	1	1	2.60	2.60
Do	8-29	1	¼	2.60	.65
Do	9-3	1	1	2.60	2.60
Total labor					75.07

Material	Date	Amount in units	Amount used	Price per unit	Cost
2¼" casing	7-24	224 lin. ft.	224 lin. ft.	$0.11	$24.64
2" casing 4/8 10/12	7-24	160 lin. ft.	160 lin. ft.	.11	17.60
½ quarter round	7-28	1 pc.	16	.04	.64
1 x 6 x 12' No. 1 W. P	7-28	1 pc.	6	.24	1.44
12' long 2" casing	7-30	8	96 lin. ft.	.11	10.56
1⅜" x 10 corner bead trim.	7-30	2 pcs.	20	.18	3.60
2¼" casing	9-2	24 lin. ft.		.11	2.64
2" casing	8-18	24 lin. ft.		.11	2.64
Total material					63.76
Total labor and material					138.83

Component 14.—Doors

The installation of combination doors was one of the first jobs done after the roof section had been completed. Installation of the doors, along with the setting of the fixed glass, enclosed the house and provided protection for stored material and the workmen during inclement weather.

The installation of the interior doors, door jambs, and hardware was done after the partitions were in place and the wallboard applied. All doors were sanded and prefinished prior to the hanging operation.

COMPONENT 14.—DOORS (HOUSE A)

A.—JAMB

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-8	1	1	$2.50	$2.50
Carpenter, foreman	7-8	1	1	2.75	2.75
Laborer, unskilled	7-8	1	2¼	1.85	4.16
Carpenter, skilled	7-10	1	4½	2.50	11.25
Do	7-21	3	4¾	2.50	11.88
Do	7-24	2	2	2.50	5.00
Total labor					37.54

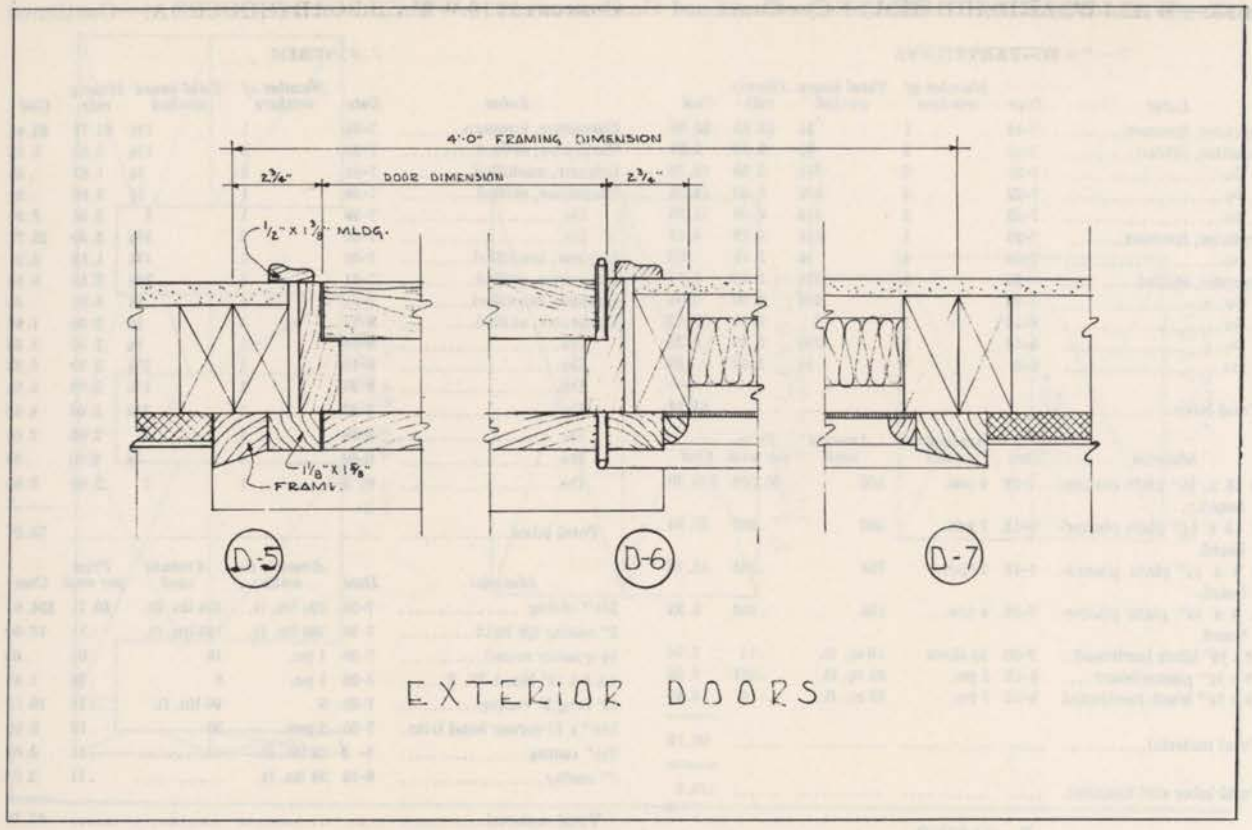


FIGURE 37.

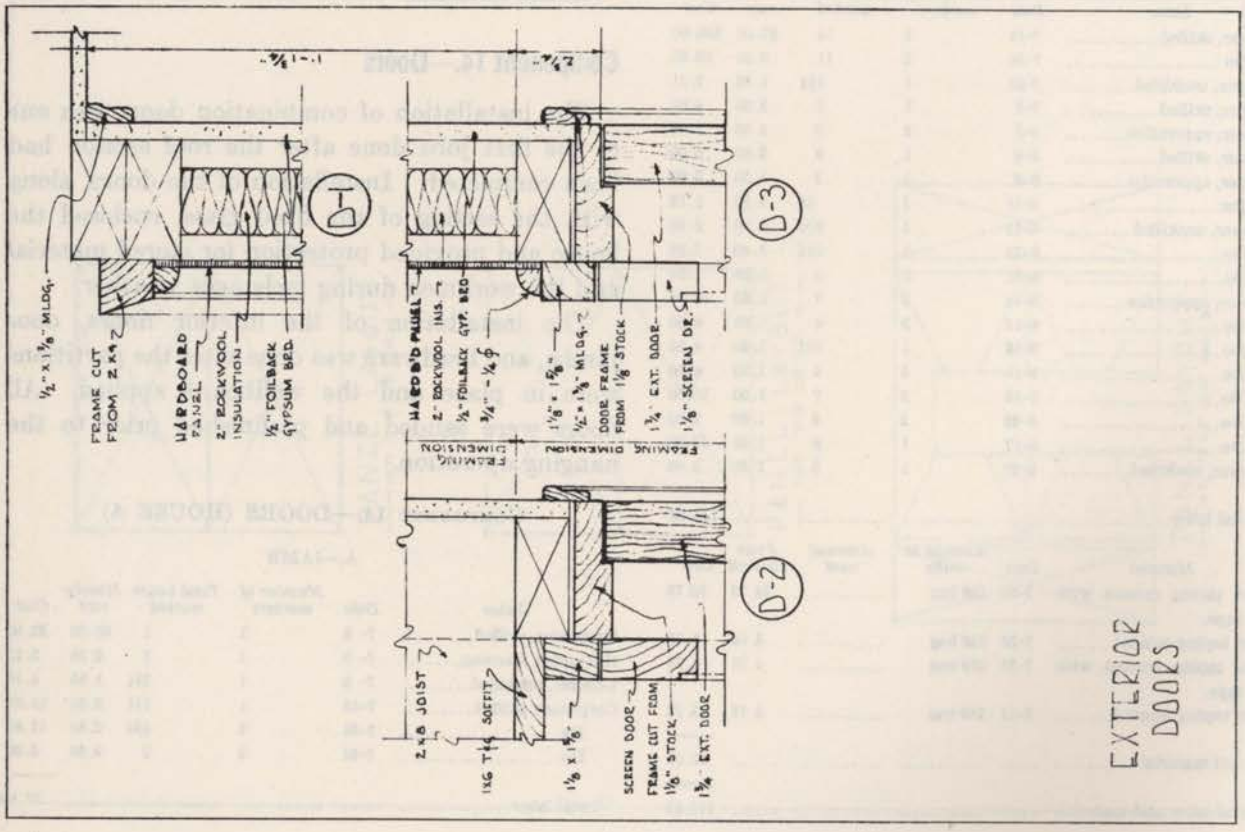


FIGURE 36.

COMPONENT 14.—DOORS (HOUSE A)—Continued

A.—JAMB—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
6/4 x 6" C. W. P	7- 7	72 lin. ft.	54 bd. ft.	$0.45	$24.30
1 x 4 x 14' C. W. P	7-18	4 pcs.	19 bd. ft.	.42	7.98
1 x 4 x 16' C. W. P	7-18	1 pc.	5 bd. ft.	.42	2.10
1⅜ stops	7-24	150 lin. ft.	150 lin. ft.	.065	9.75
1 x 6 x 16' No. 1 W. P	7-25	2 pcs.	16 bd. ft.	.24	3.84
1 x 6 x 12' No. 1 W. P	8-12	1 pc.	6 bd. ft.	.24	.96
Total material					48.93
Total labor and material					86.47

B.—TRIM

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-11	1	3¼	$2.50	$8.13
Do	7-24	1	1¾	2.50	4.38
Laborer, unskilled	7-24	1	1½	1.85	2.78
Carpenter, foreman	7-24	1	1½	2.75	4.12
Carpenter, skilled	7-25	3	2½	2.50	6.25
Carpenter, foreman	7-25	1	2¼	2.75	6.19
Carpenter, skilled	7-29	1	2	2.50	5.00
Do	8-12	1	2¼	2.50	5.63
Laborer, unskilled	8-12	1	¼	1.85	.46
Carpenter, skilled	8-13	1	¾	2.50	1.88
Do	8-28	2	7¾	2.60	20.15
Total labor					64.97

Material	Date	Amount in units	Amount used	Price per unit	Cost
5/4 x 16" x 8' clear W. P	6-26	1 pc.	14 bd. ft.	$0.45	$6.30
5/4 x 6"—8' C. V. G. fir	7- 7	5	25 bd. ft.	.36	9.00
1 x 6 x 12' No. 1 W. P	7-24	3 pcs.	18 bd. ft.	.24	4.32
Total material					19.62
Total labor and material					84.59

C.—HANGING (HINGES)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-11	1	¾	$2.50	$1.88
Do	7-14	1	4¾	2.50	11.88
Do	7-16	1	½	2.50	1.25
Do	7-23	1	5	2.50	12.50
Do	7-24	1	7	2.50	17.50
Do	8-29	1	1	2.60	2.60
Total labor					47.61

Material	Date	Amount in units	Amount used	Price per unit	Cost
Cadmium surface spring hinges.	7-7	3 pair	3 pair	$1.39	$4.17
4" butts	7-23	4½ pair		.85	3.78
3½" butts	7-23	6 pair		.85	5.04
Total material					12.99
Total labor and material					60.60

D.—HARDWARE (LOCKSETS)

Labor	Date	Number of workers	Total hours worked	Rate	Cost
Carpenter, skilled	7-24	1	1	$2.50	$2.50
Do	7-25	1	3½	2.50	8.75
Do	9-3	1	¾	2.60	1.95
Do	9-18	1	3	2.60	7.80
Do	9-19	1	¼	2.60	.65
Total labor					21.65

COMPONENT 14.—DOORS (HOUSE A)—Continued

D.—HARDWARE (LOCKSETS)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
Aluminum ideal bare latches	7-7	3 pair	3 pair	$1.25	$3.75
Ideal spring safety chain	7-7	3 pair	3 pair	.65	1.95
Privacy lock—bath	7-23	1		6.50	6.50
Privacy locks—bedrooms	7-23	3		6.50	19.50
Exterior locks—keyed alike	7-23	2		12.50	25.00
Oak thresholds	8-27	3		.75	2.25
A 51-lock set	9-2	1			4.95
3/0 x 6/8 8 lt. combination door.	7-7	1			19.77
2/8 x 6/8 combination door	7-7	2		18.92	37.84
3/0 x 6/8 1⅜ 2 panel door	7-7	1			19.99
3/0 x 6/8 1¾ solid core birch door.	7-23	1			45.00
2/8 x 6/8 1¾ solid core birch door.	7-23	2		40.05	80.10
2/6 x 6/8 1⅜ hollow core birch door.	7-23	3		16.81	50.43
2/4 x 6/8 1⅜ hollow core birch door.	7-23	1			16.14
Total material					333.17
Total labor and material					354.82

Component 15.—Septic tanks

Most of the necessary trenching was done by hand labor. The plumber ran the building drain 5′ outside of the building foundation. At this point, 6″ vitrified glazed tile with sealed bell joints was connected and run to the septic tank. The tank was a 500-gallon precast concrete unit set to a depth so that the inlet was 2′–6″ below the finish grade.

The distribution box was also a precast unit and was set approximately 25′ from the septic tank. For the distribution field, 4″ field tile with open joints were laid in a 2′ trench, directly on top of 6″ of ¾″ crushed rock. The tile joints were covered with felt. Two inches of crushed rock were placed over the tile and the rest of the trench filled with earth. The slope of the disposal field equals 4″ in 100′. (See layout on plot plan drawings, figures 6 and 59).

COMPONENT 15.—SEPTIC TANKS (HOUSE A)

A.—COMPLETE INSTALLATION

1.—TANK AND DISTRIBUTION BOX

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Foreman	6-6	1	½	$1.85	$0.93
Laborer, unskilled	6-6	1	1½	1.85	2.78
Laborer, skilled	6-7	2	10½	2.00	21.00
Laborer, unskilled	6-9	2	4¼	1.85	7.86
Foreman	6-9	1	6¾	1.85	12.49
Laborer, unskilled	6-10	3	13½	1.85	24.98
Do	6-11	4	10	1.85	18.50
Do	6-16	6	5¼	1.85	9.71
Laborer, skilled	6-16	5	4	2.00	8.00
Laborer, unskilled	6-19	3	2½	1.85	4.63
Total labor					110.88

A.—COMPLETE INSTALLATION—Continued
1.—TANK AND DISTRIBUTION BOX—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
Septic tank	6-10	1	1	$76.10	$76.10
Distribution box	6-10	1	1	10.00	10.00
Total material					86.10
Total labor and material					196.98

2.—FIELD

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-9	2	8	$1.85	$14.80
Do	6-10	3	4¼	1.85	7.86
Do	6-11	4	3¼	1.85	6.01
Do	6-13	2	1	1.85	1.85
Machine operator and tractor	6-13	1	¾	7.50	5.61
Laborer, unskilled	6-16	5	19¾	1.85	36.54
Laborer, skilled	6-16	1	¾	2.00	1.50
Laborer, unskilled	6-17	8	12½	1.85	23.13
Laborer, skilled	6-17	1	3½	2.00	7.00
Laborer, unskilled	6-18	2	6½	1.85	12.03
Total labor					116.33
Total material					None
Total labor and material					116.33

Component 16.—Cabinets

A—KITCHEN. For the construction of the kitchen cabinets, all of the power equipment was set up in the living-room area, a work table being made from a sheet of plywood and two saw horses. All material for the wall-hung units was precut. All joints were glued and nailed. Screws were then applied at all corners near the front and rear edges.

To install these units, two 1″ x 2″ were placed on the walls as supports. The units fitted directly over these supports and were nailed from the top and bottom of each of the outlining members. The wall sections formed the back of each unit, being an economy measure to reduce the material cost.

The sliding hardboard doors were precut; metal-edging strips were applied with glue to the two vertical sides; finger holes were bored; and then the doors were fitted into the cabinet units.

The base cabinets were built in place, the wall sections being used as the back of the units. All parts of equal dimensions—drawers, doors, and exterior trim pieces—were precut prior to the assembly operation.

Three-fourth inch plywood was used as the counter top. This was trimmed with metal-edging strips and a plastic material was applied as the finished surface.

A.—KITCHEN 1.—BASE

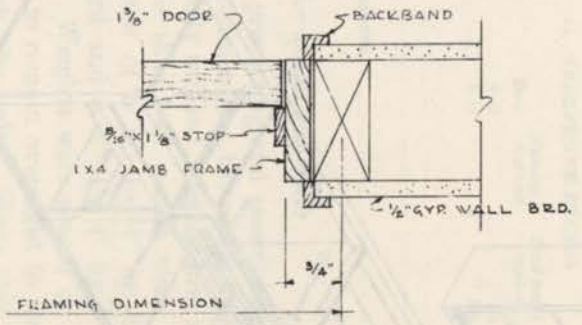
Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-28	1	1½	$2.50	$3.75
Do	7-29	2	8¼	2.50	20.63
Laborer, unskilled	7-29	1	5¼	1.85	9.71
Do	7-30	1	2	1.85	3.70
Carpenter, skilled	7-31	1	3½	2.50	8.75
Laborer, unskilled	7-31	1	2	1.85	3.70
Carpenter, skilled	8-18	1	1	2.50	2.50
Do	8-19	3	12½	2.50	31.25
Do	8-20	2	2¼	2.50	5.63
Total labor					89.62

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ No. 1 W. P	7-28	2 pcs.	12	$0.24	$2.88
4 x 8 ¾″ fir plywood SOIS	7-28	4 pcs.	128 bd. ft.	.35	44.80
2 x 4 x 16′ No. 1 and 2 fir	7-28	2 pcs.	21 bd. ft.	.145	3.05
1 lb. wood putty	7-30	1 can	1 can		.35
1 x 8 x 12′ CVG fir	7-30	1 pc.	8 bd. ft.	.34	2.72
4 x 8 x ⅛″ black hardboard	7-30	½ sheet	16 sq. ft.	.14	2.24
1 x 6 x 12′ No. 1 W. P	7-31	3 pcs.	18 bd. ft.	.24	4.32
Door catches	8-12	5		.90	4.50
Hinges (full surface-cabinet door)	8-12	15 pr.		.15	2.25
Spring door catches	8-12	11		.20	2.20
Door knobs	8-12	13		.10	1.30
Wood pulls	8-18	5		.30	1.50
Red lines cabinet top covering	8-19	16 lin. ft.		.89	35.60
Mastic	8-19	2 qts.		1.25	2.50
T. Mldg	8-19	3 lin. ft.		.18	.54
Edg	8-19	24 lin. ft.		.23	5.52
Cove	8-19	18 lin. ft.		.21	3.78
Mastic	8-19	1 qt.			1.15
12′ SS Cts. Edg	8-20	12 ft.		.23	2.76
Total material					123.96
Total labor and material					213.58

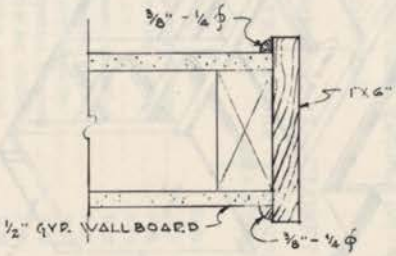
2.—WALL

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-13	1	6¼	$2.50	$15.63
Do	8-18	1	4	2.50	10.00
Do	8-19	2	14½	2.50	36.25
Do	8-27	2	16	2.60	41.60
Do	8-28	2	16	2.60	41.60
Laborer, unskilled	8-28	1	1½	1.50	2.25
Carpenter, skilled	9-18	1	½	2.60	1.30
Total labor					148.63

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 10 x 14′ CWP	7-30	2 pcs.	23 bd. ft.	$0.42	$9.66
1 x 12 x 16′ CWP	7-30	2 pcs.	32 bd. ft.	.45	14.40
1 x 12 x 14′ CWP	8-18	2 pcs.	28 bd. ft.	.45	12.60
4 x 8 x ⅛″ plain hardboard	8-18	1 pc.	32	.11	3.52
Pilaster strips	8-18	20 lin. ft.	20	.10	2.00
Shelf cleats	8-18	28		.03	.84
Cap Mldg	8-20	39 lin. ft.		.18	7.02
Do	8-20	16 lin. ft.		.18	2.88
Chrome pulls	8-21	9		.06	.54
4 x 8 x ¾″ fir plywood SOIS	7-28	2	64 bd. ft.	.35	22.40
1 x 4 x 14′ CWP	8-25	1	5 bd. ft.	.42	2.10
Total material					77.96
Total labor and material					226.59

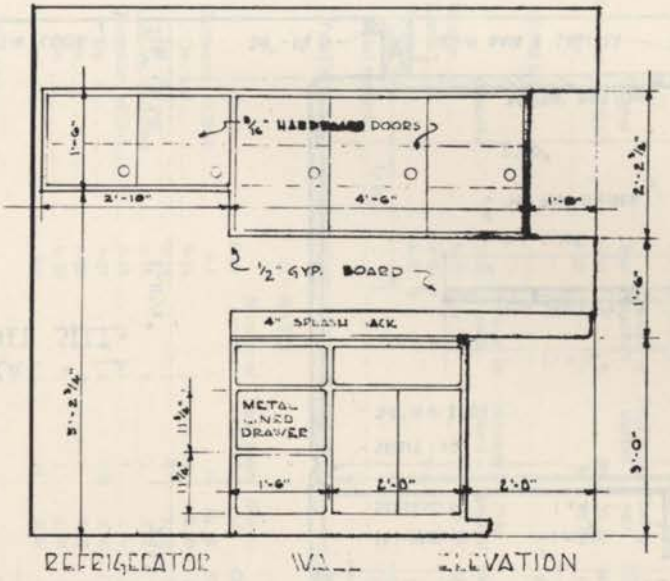


INTERIOR DOOR DETAIL
HEAD SIMILAR
SCALE — 3"=1'-0"

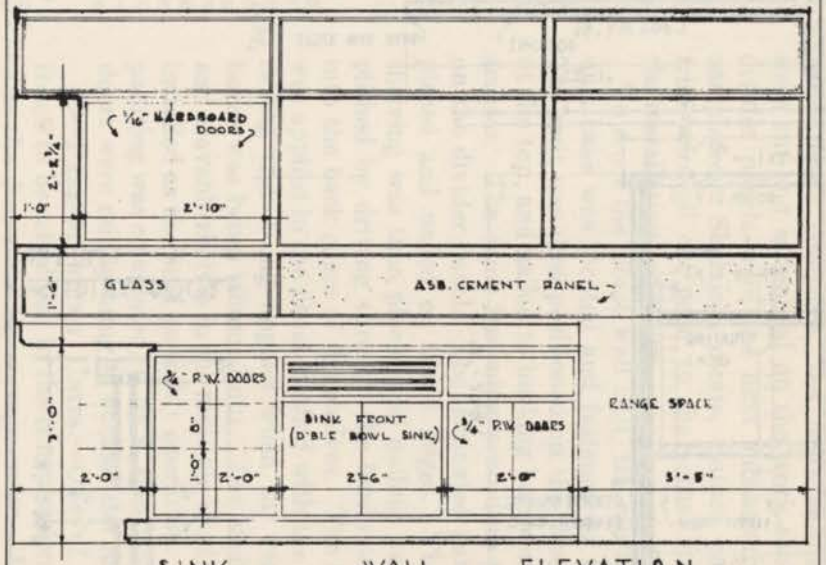


JAMB CASING DETAIL

FIGURE 38.—*Interior opening details.*



REFRIGERATOR WALL ELEVATION



SINK WALL ELEVATION

FIGURE 39.—*Kitchen elevations.*

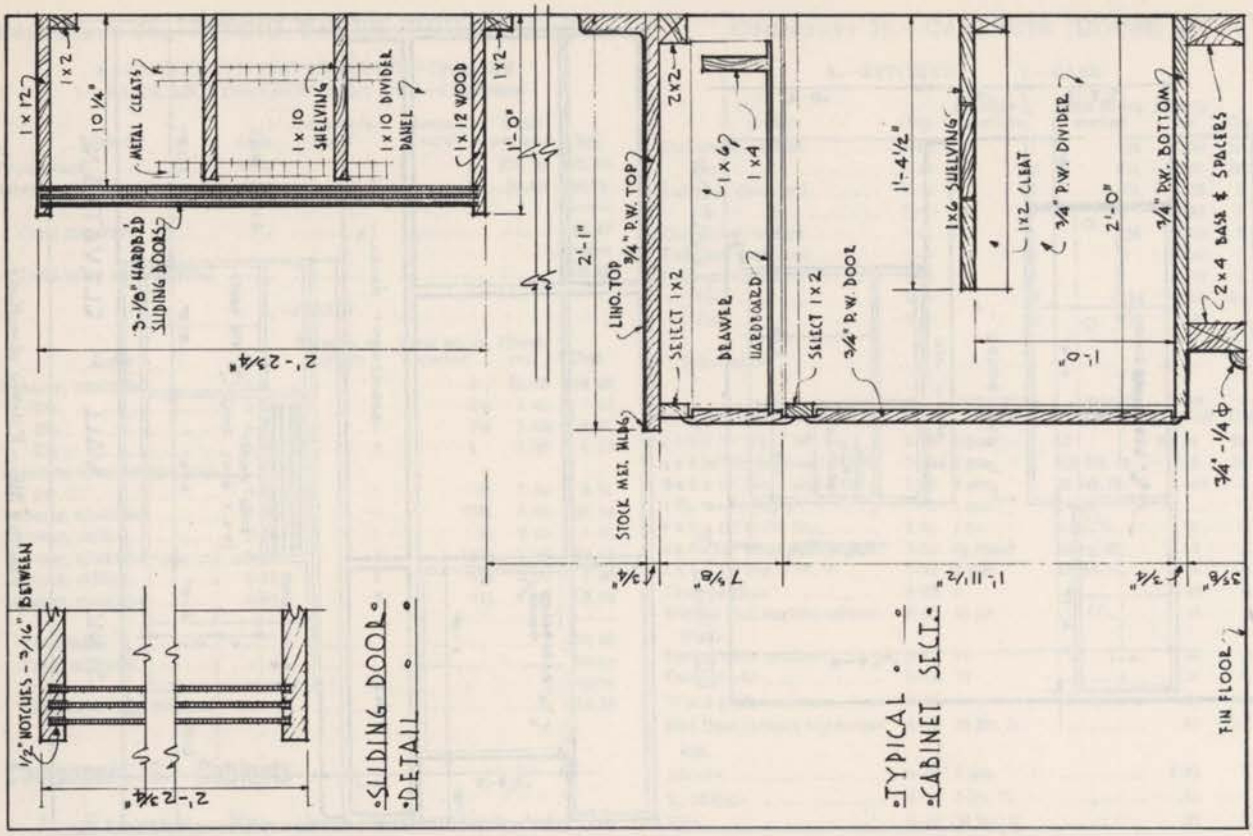


FIGURE 41.

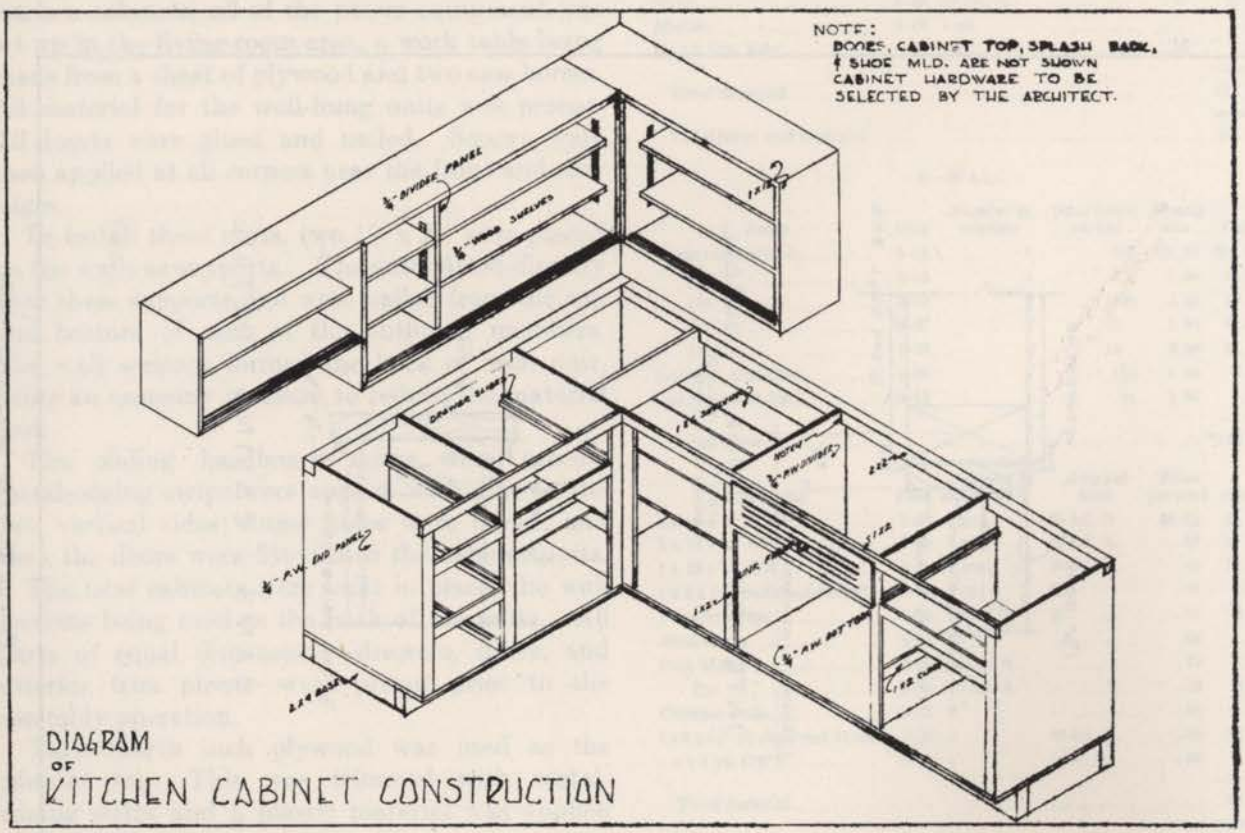


FIGURE 40.

COMPONENT 16.—CABINETS (HOUSE A)—Continued

B.—UTILITY

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-19	1	2¾	$2.50	$6.88
Do	8-22	1	¾	2.60	1.95
Total labor					8.83

Material	Date	Amount in units	Amount used	Price per unit	Cost
Hinges	8-19	2 pr.		$0.55	$1.10
Knob	8-22	1		.20	.20
Catches	8-22	2		.30	.60
Total material					1.90
Total labor and material					10.73

C.—BATH

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-1	1	½	$2.50	$1.25
Do	8-13	1	1	2.50	2.50
Do	8-14	1	3	2.50	7.50
Laborer, unskilled	8-14	1	1	1.85	1.85
Carpenter, skilled	8-18	1	1	2.50	2.50
Do	8-27	1	4½	2.60	11.70
Do	8-28	2	3	2.60	7.80
Do	8-29	1	1	2.60	2.60
Do	9-3	1	½	2.60	1.30
Total labor					39.00

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 4 x 10′ CWP	7-30	3 pcs.	10 bd. ft.	$0.42	$4.20
1 x 12 x 16′ CWP	7-30	1 pc.	16 bd. ft.	.45	7.20
Pilaster strips	8-18	4 lin. ft.		.10	.40
Shelf cleats	8-18	4		.03	.12
Hinges 7630	9-2	1 pr.			.30
Door catch	9-3	1			.90
Total material					13.12
Total labor and material					52.12

D.—TELEPHONE RECESS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-12	1	½	$2.50	$1.25
Do	8-14	1	1½	2.50	3.75
Total labor					5.00
Total material					None
Total labor and material					5.00

Component 17.—Closet wall units

Using the precutting and assembling technique again for this component, the power tools and work bench were fully utilized. As the first step in this operation the thin wall panels were laminated. (This consisted of a ⅜″ by 4′ by 8′ sheet of gypsum board and a ⅛″ by 4′ by 8′ tempered hardboard.) Weights were placed on the panels and allowed to remain overnight to insure a firm bond between the units. Since this work took place in the corner of a bedroom, it did not interrupt other work going on in the house. After the panels were complete, the multiple-shelf units were cut and assembled on the work table. The divider panels were the next subassembly units completed. Shelving, cleats, clothes poles, and trim were all cut prior to the actual starting of the installation procedure.

To erect the closet wall unit, the multiple shelf unit base was located and fastened to the floor. The unit was then positioned on the base, shimed at the top, and nailed to backing between the roof trusses. The same fastening procedure was used on the divider panel. The laminated panels were placed and nailed on the 4 edges. The precut shelving was then placed and nailing was accomplished by driving through the laminated panels into the back edges of the shelves. The face trim was applied in the usual method with the base and ceiling trim being applied when the rest of the house was being trimmed out. The shelf bracket and movable shelves in the multiple-shelf unit were installed as the final assembly operation. After all painting was completed, 4′ by 8′ split wood sliding doors were ceiling hung to enclose the closet unit.

C—FREE-STANDING UNITS.—One of the last items to be scheduled in the construction program was the free-standing storage units. Using the power equipment set up in the living room area of the house, all of the material that formed the structural members of the units were precut. The units were then constructed on an individual basis, including the application of the hardboard on the exterior surfaces. It was noted during the construction of these units that it was extremely difficult to achieve a satisfactory appearance in the finished product. The utilization of better quality materials would have reduced this difficulty somewhat.

COMPONENT 17.—CLOSET WALL UNITS (HOUSE A)

A.—FRAMEWORK (INCLUDES SHELVES, CLOSET POLE, HANGERS, AND TRIM)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-21	1	4	$2.75	$11.00
Carpenter, skilled	7-21	3	2	2.50	5.00
Do	7-22	6	20¼	2.50	50.63
Laborer, unskilled	7-22	1	1½	1.85	2.78
Carpenter, skilled	7-23	5	12¾	2.50	31.88
Laborer, unskilled	7-23	1	¼	1.85	.46
Carpenter, foreman	7-23	1	1¾	2.75	4.81
Carpenter, skilled	7-24	2	9¼	2.50	23.13
Laborer, unskilled	7-25	1	¼	1.85	.46
Carpenter, skilled	7-28	2	4	2.50	10.00
Do	8-19	1	¾	2.50	1.88
Carpenter, apprentice	8-22	1	½	1.50	.75
Laborer, unskilled	8-22	1	1¼	1.50	1.88
Total labor					144.66

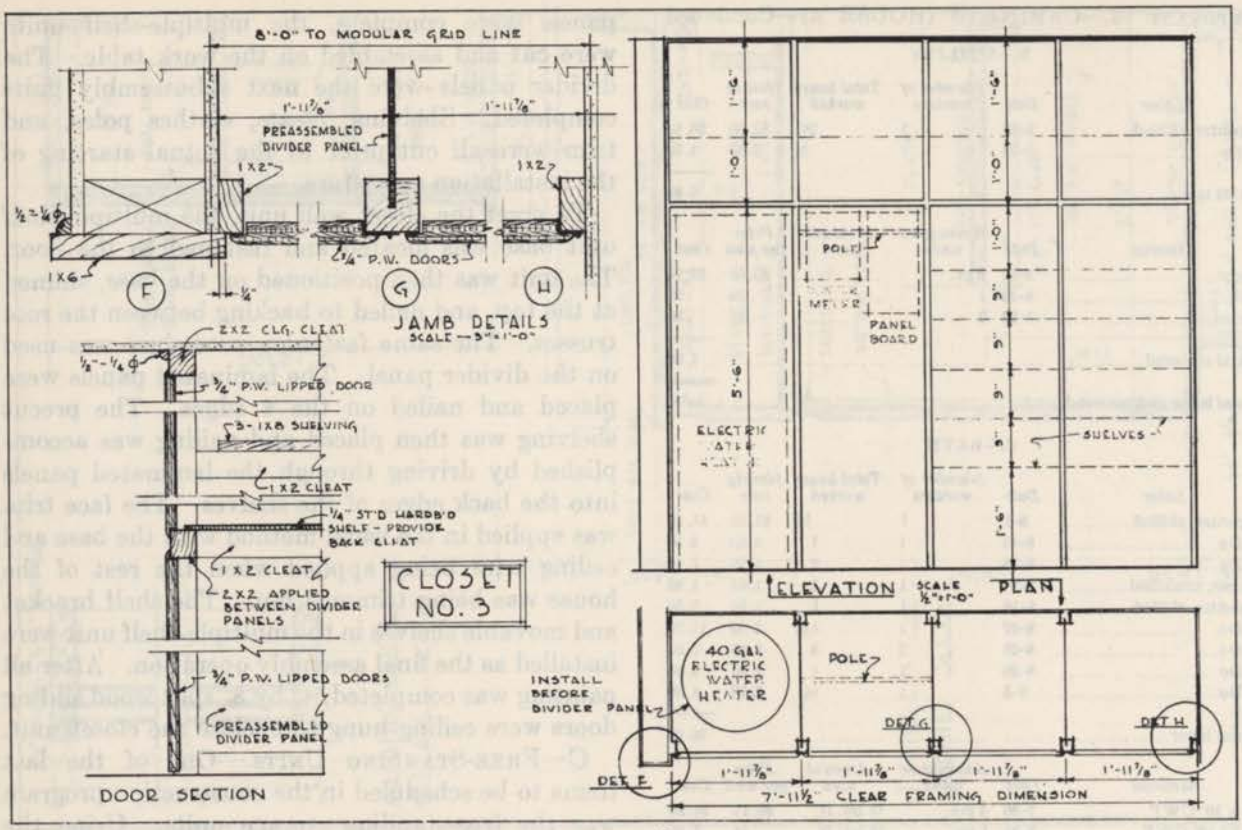


FIGURE 43.—*Closet details—closet No. 3.*

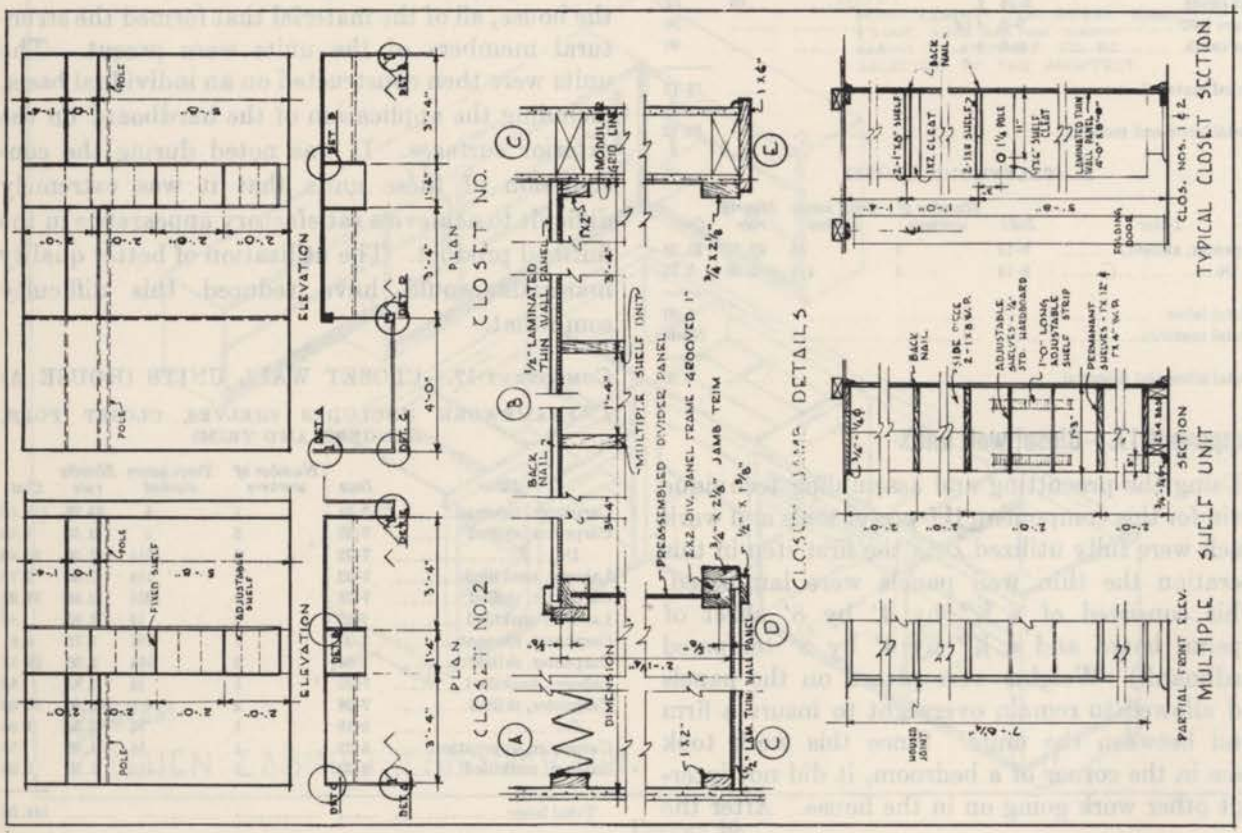


FIGURE 42.—*Closet details—closets No. 1 and No. 2.*

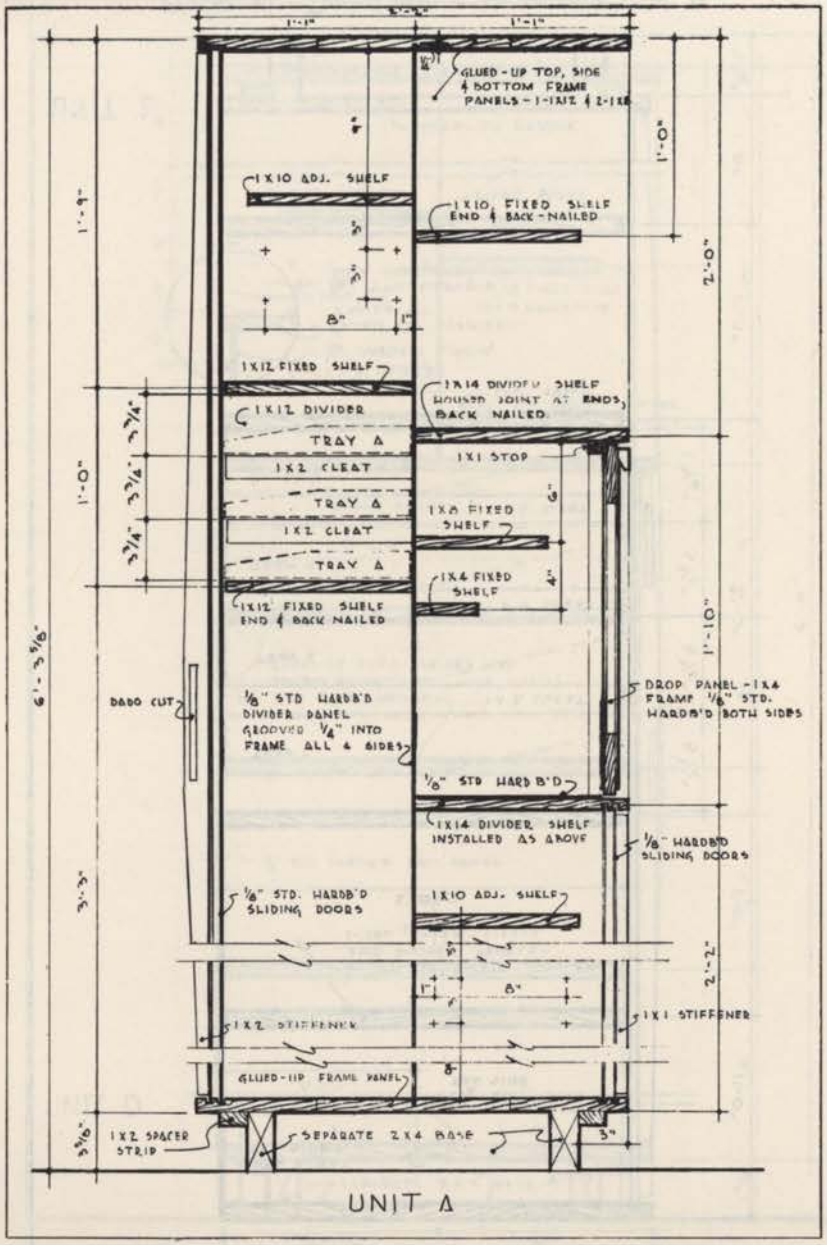


FIGURE 44.—*Typical section—storage units—Unit A.*

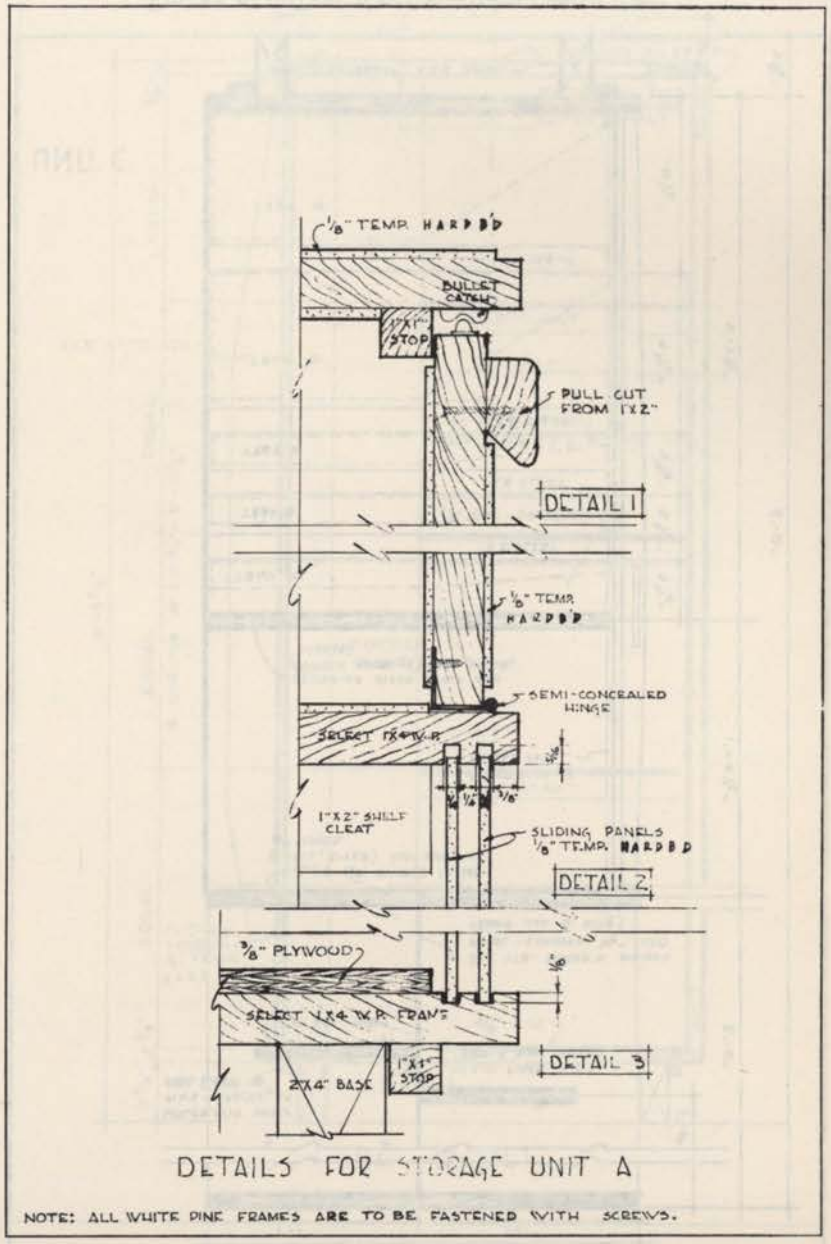


FIGURE 45.

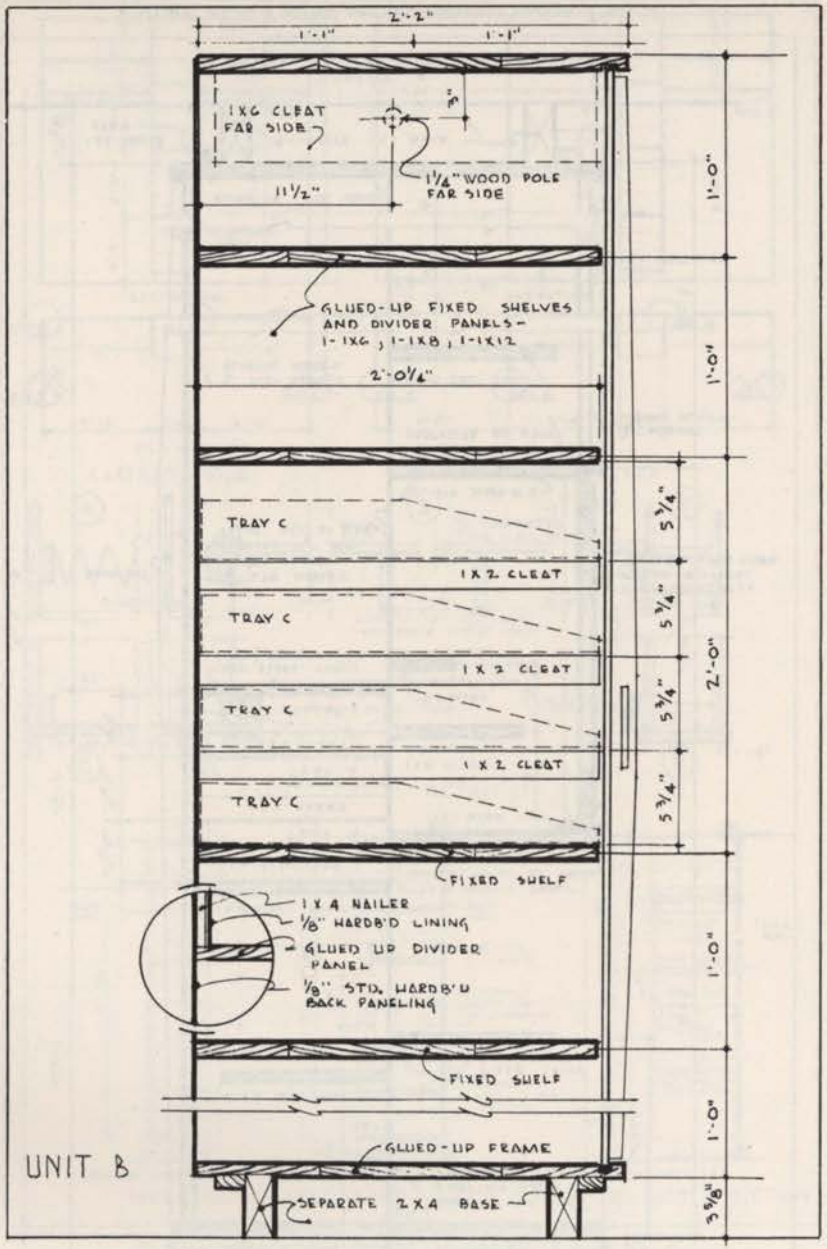


FIGURE 46.—*Typical section—storage units—Unit B.*

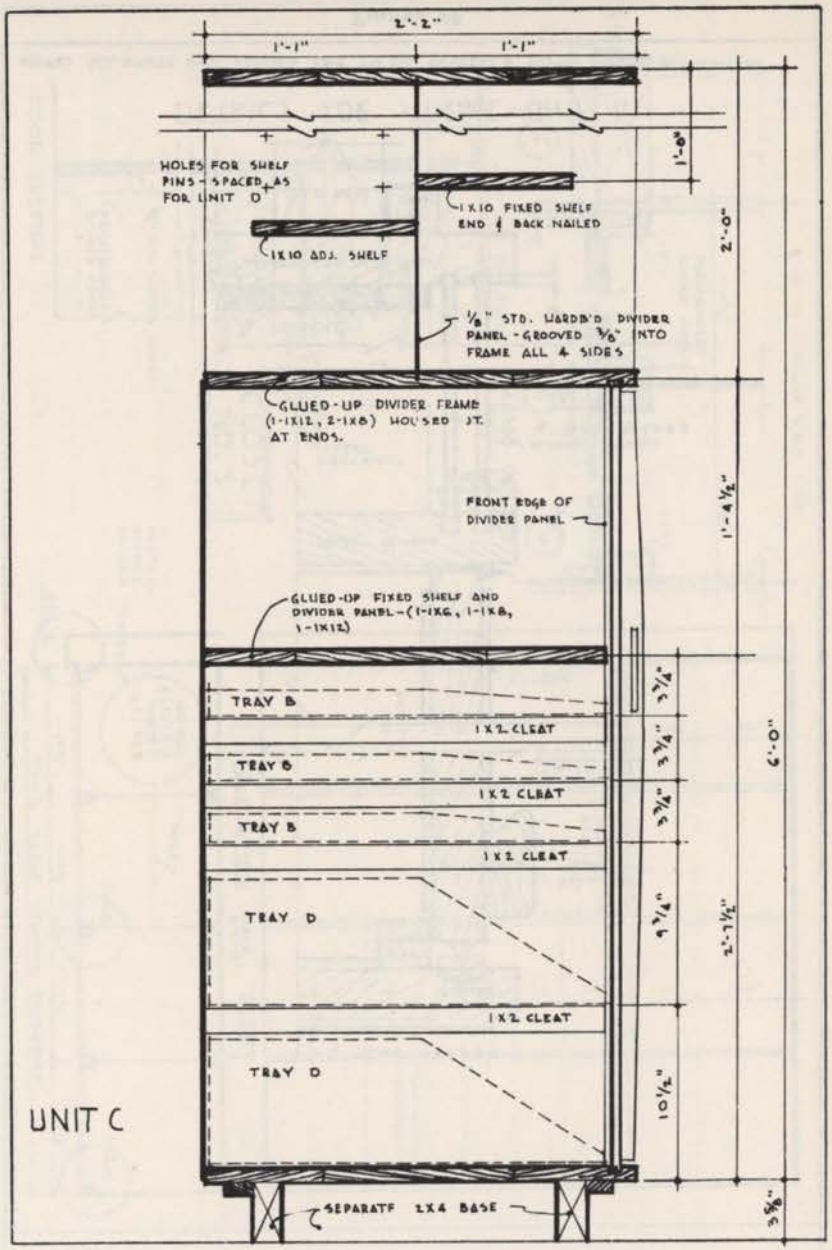


FIGURE 47.—*Typical section—storage units—Unit C.*

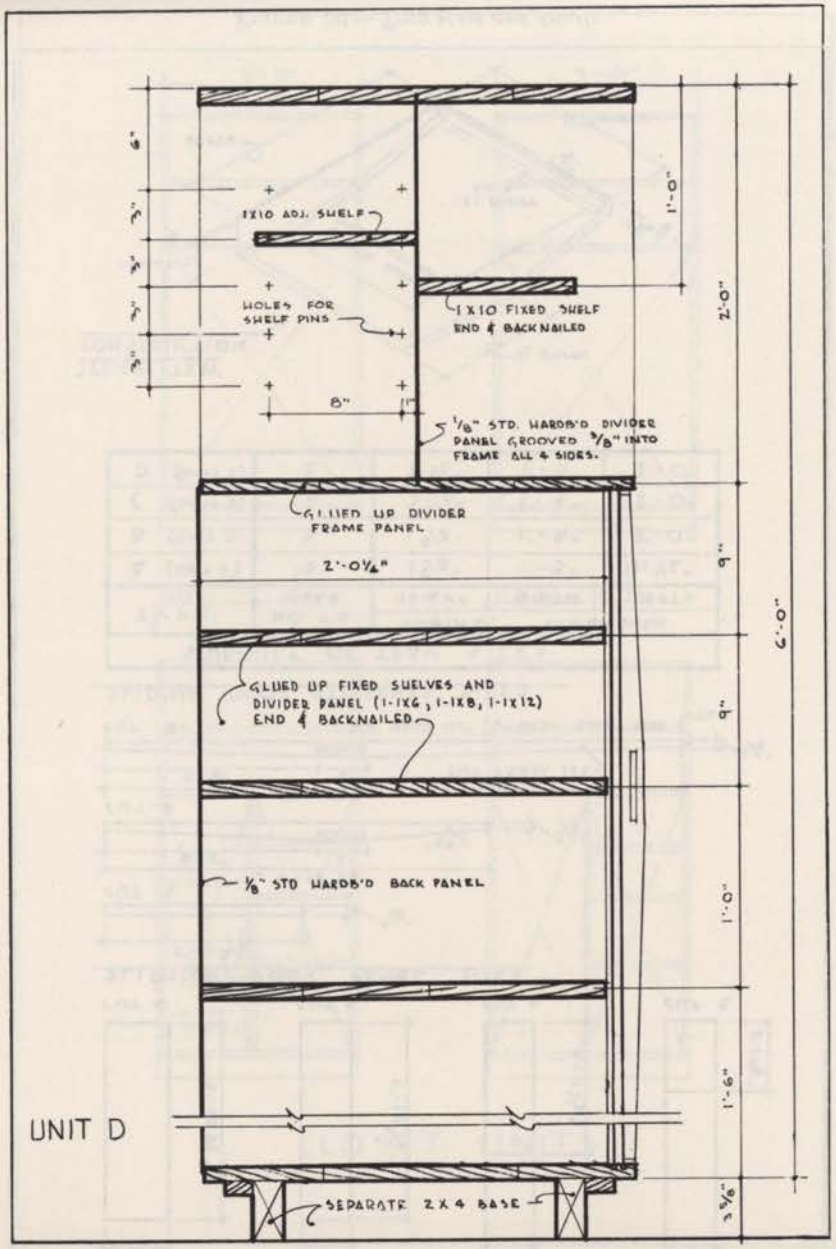


FIGURE 48.—*Typical section—storage units—Unit D.*

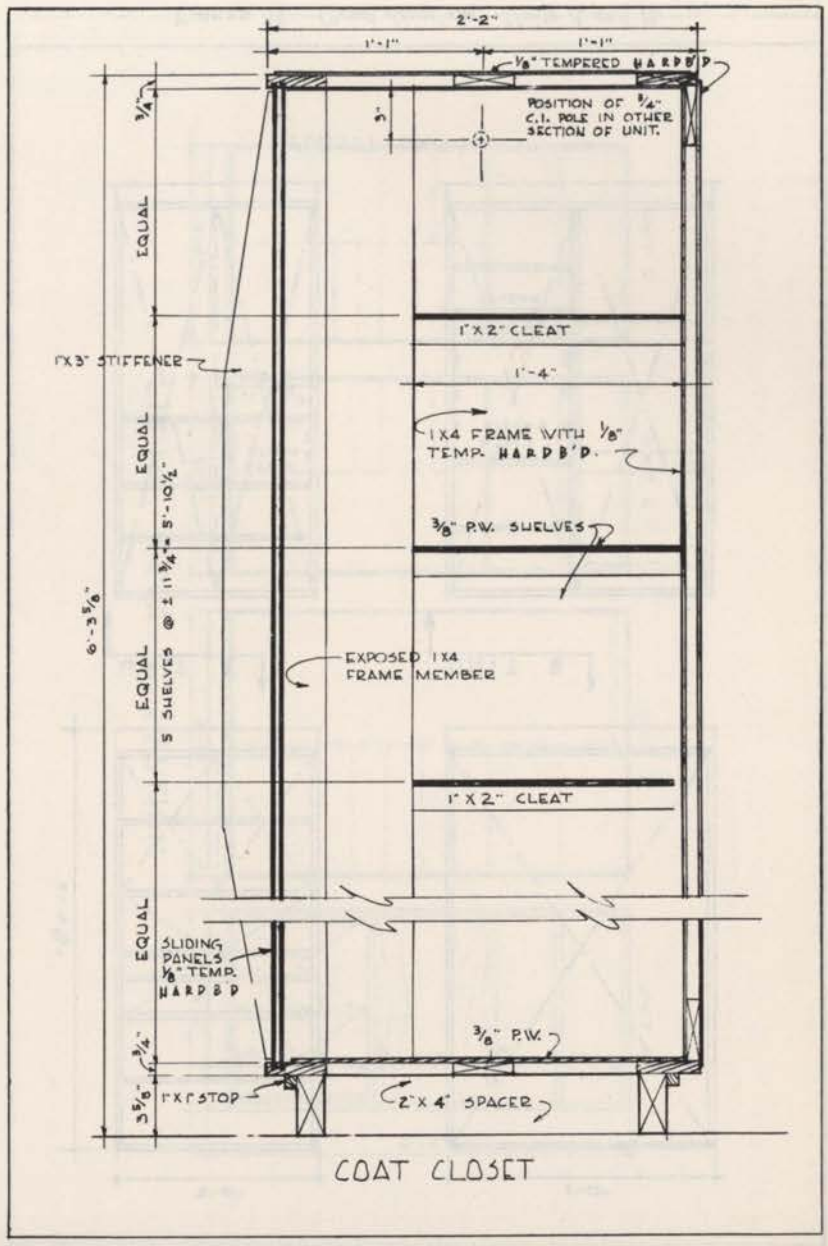
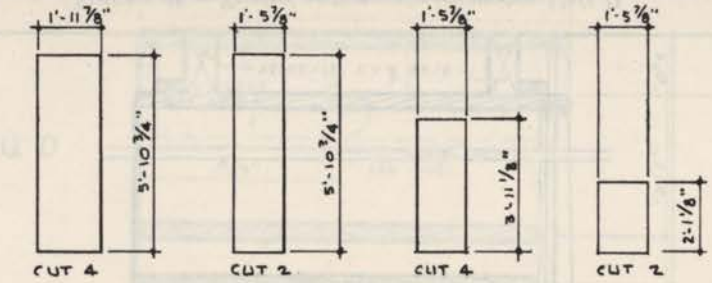
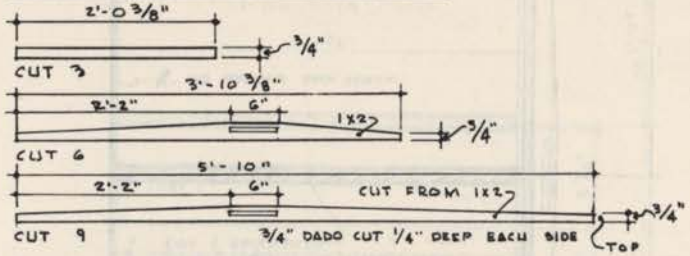


FIGURE 49.—*Typical coat closet.*



SLIDING DOOR PANEL SIZES



SLIDING DOOR STIFFENER SIZES

SCHEDULE OF TRAY SIZES

TYPE	NO. TO MAKE	NOMINAL DIMENSION		
		HEIGHT	WIDTH	DEPTH
A (UNIT A)	3	1 5/8"	1'-3"	11 1/2"
B (UNIT B)	3	1 5/8"	1'-3"	2'-0"
C (UNIT B)	4	3 5/8"	1'-9"	2'-0"
D (UNIT B)	2	7 1/2"	1'-3"	2'-0"

TYPICAL TRAY CONSTRUCTION

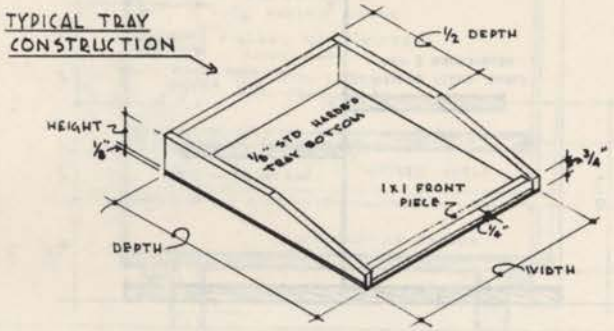


FIGURE 50.—*Tray sizes and details.*

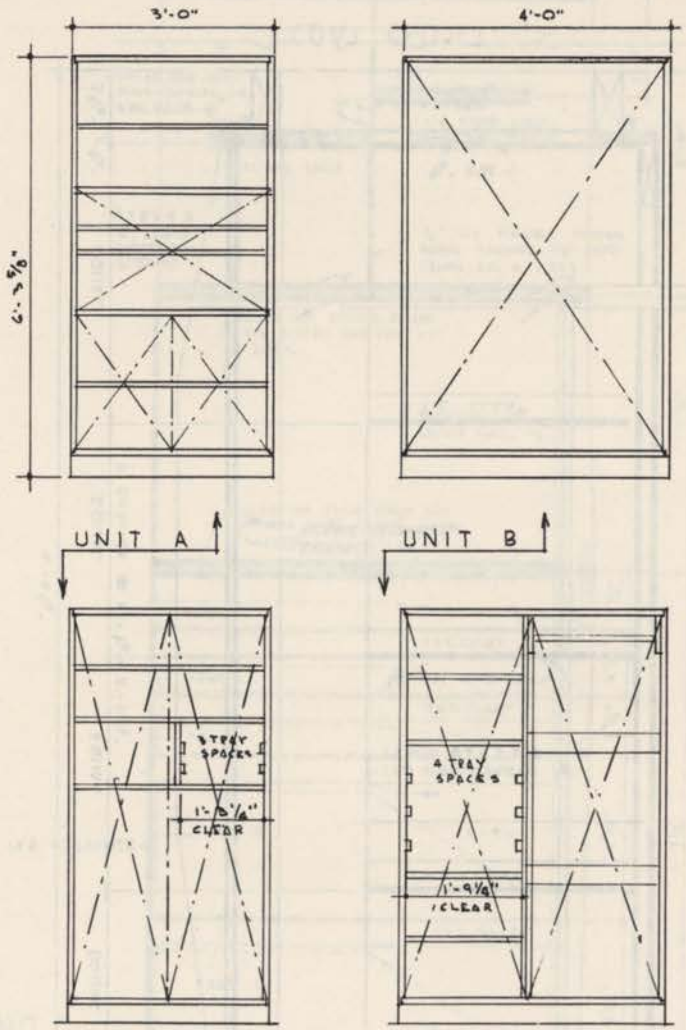


FIGURE 51.—*Closet elevations—Units A and B.*

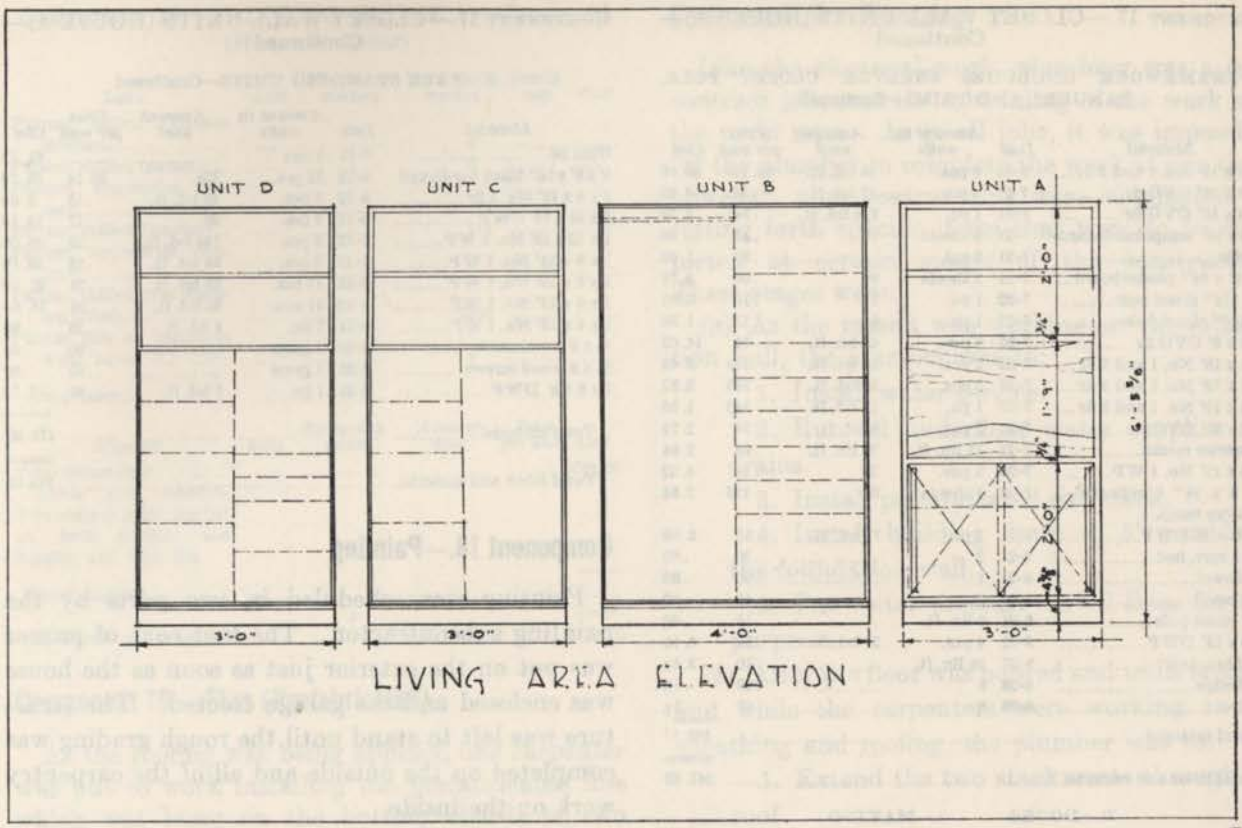


FIGURE 53.—*Storage units—living area elevation.*

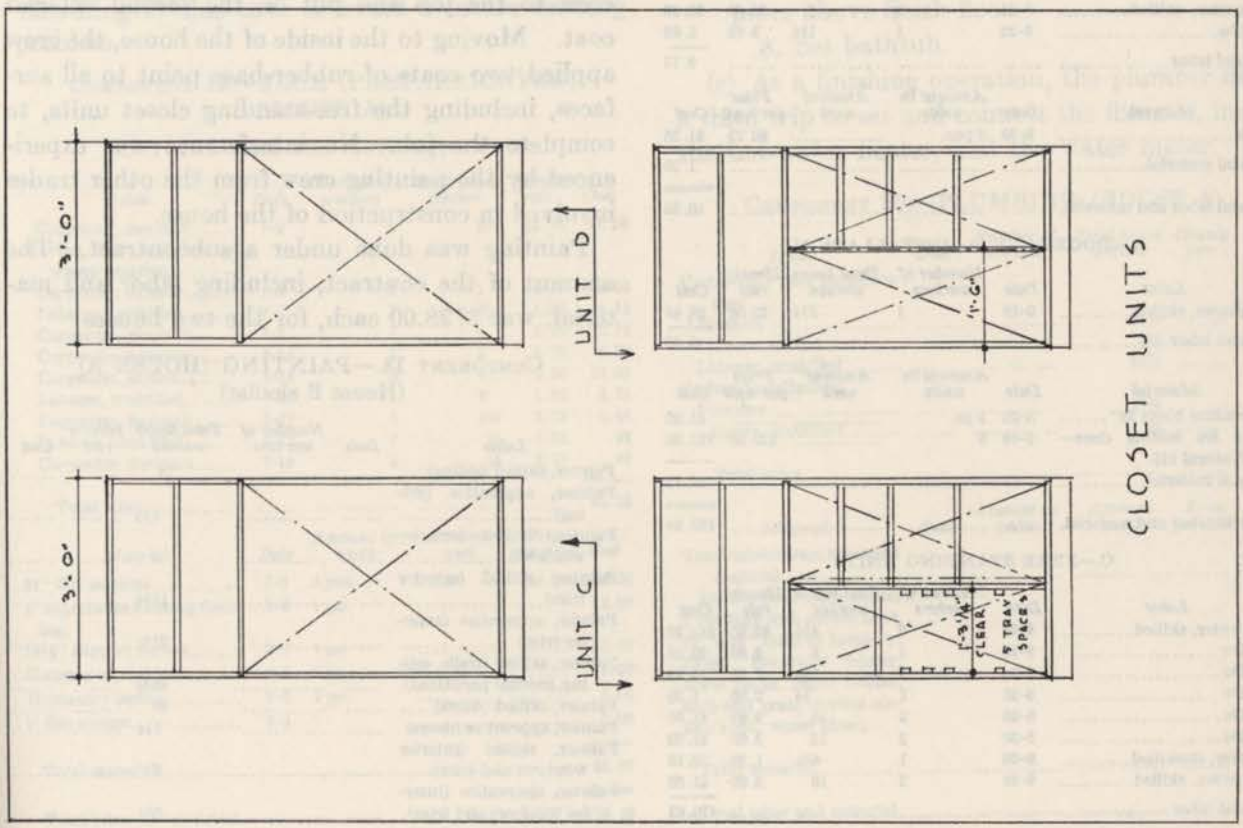


FIGURE 52.—*Closet elevations—Units C and D.*

COMPONENT 17.—CLOSET WALL UNITS (HOUSE A)—Continued

A.—FRAMEWORK (INCLUDES SHELVES, CLOSET POLE, HANGERS, AND TRIM)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12′ No. 1 and 2 fir	7-21	6 pcs.	48 bd. ft.	$0.145	$6.96
1 x 8 x 16′ CVG fir	7-21	4 pcs.	43 bd. ft	.34	14.62
1 x 4 x 16′ CVG fir	7-21	1 pc.	5⅓ bd. ft.	.34	1.70
4 x 8 x ⅛″ temp. hardboard	7-21	3 sheets	96	.11	10.56
Mastic	7-21	2 gal.		.80	1.60
4′ x 8′ x ⅜″ plasterboard	7-21	3 sheets	96	.06	5.76
14′ 1¼″ closet pole	7-22	1 pc.	14	.15	2.10
8′ 1⅜″ closet pole	7-22	1 pc.	8	.17	1.36
1 x 8 x 8′ CVG fir	7-22	8 pcs.	43 bd. ft.	.34	14.62
2 x 4 x 18′ No. 1 and 2 fir	7-22	2 pcs.	24 bd. ft.	.145	3.48
2 x 4 x 12′ No. 1 and 2 fir	7-23	2 pcs.	16 bd. ft.	.145	2.32
2 x 4 x 16′ No. 1 and 2 fir	7-23	1 pc.	11 bd. ft.	.145	1.55
1 x 4 x 12′ CVG fir	7-25	2 pcs.	8 bd. ft.	.34	2.72
¾ quarter round	7-25	71 lin. ft.	71 lin. ft.	.04	2.84
1 x 6 x 12′ No. 1 WP	7-28	3 pcs.	18	.24	4.32
2 x 8 x ⅛″ hardboard—2 sides temp.	7-23	4 sheets	64	.125	7.84
1 x 10—10′ DWP	8-21	2 pcs.	17 bd. ft.	.35	5.96
½ x 5 corr. fast	8-21	2		.30	.60
⅜″ dowel	8-21	1		.06	.06
Catches	8-21	2		.10	.20
1⅛″ closet pole	8-21	6 lin. ft.		.15	.90
1 x 6 x 12′ DWP	8-22	4 pcs.	24 bd. ft.	.35	8.40
Shelf brackets	8-27	24 lin. ft.		.10	2.40
Shelf clips	8-28	5		.03	.15
Do	8-28	5		.03	.15
Total material					103.17
Total labor and material					247.83

B.—DOORS 1.—MAKING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-21	1	2	$2.60	$5.20
Do	8-22	1	1½	2.60	3.90
Total labor					9.10

Material	Date	Amount in units	Amount used	Price per unit	Cost
Pulls	9-20	5 pcs.		$0.25	$1.25
Total material					1.25
Total labor and material					10.35

B.—DOORS 2.—INSTALLATION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-19	1	3¼	$2.60	$8.45
Total labor					8.45

Material	Date	Amount in units	Amount used	Price per unit	Cost
Chromium hinge 24″	8-22	1 pc.			$1.25
4/0 x 8/0 folding door—Natural 145.	9-19	5		$29.50	147.50
Total material					148.75
Total labor and material					157.20

C.—FREE STANDING UNITS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-14	2	4½	$2.50	$11.25
Do	8-15	1	8	2.50	20.00
Do	8-18	1	5½	2.50	13.75
Do	8-21	1	½	2.60	1.30
Do	8-25	2	16	2.60	41.60
Do	8-26	2	12	2.60	31.20
Laborer, unskilled	8-28	1	6¾	1.50	10.13
Carpenter, skilled	9-18	2	16	2.60	41.60
Total labor					170.83

COMPONENT 17.—CLOSET WALL UNITS (HOUSE A)—Continued

C.—FREE STANDING UNITS—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
Glue 5#	8-11	1 can			$3.75
4′ x 8′ x ⅛″ black hardboard	8-12	12 pcs.	374	$0.14	53.76
2 x 4 x 12′ No. 1 fir	8-12	5 pcs.	40 bd. ft.	.15	6.00
1 x 14 x 14′ CWP	8-12	2 pcs.	28	.47	13.16
1 x 12 x 16′ No. 1 WP	8-12	9 pcs.	144 bd. ft.	.25	36.00
1 x 8 x 14′ No. 1 WP	8-12	9 pcs.	84 bd. ft.	.25	20.16
1 x 8 x 12′ No. 1 WP	8-12	11 pcs.	88 bd. ft.	.24	21.12
1 x 6 x 12′ No. 1 WP	8-12	11 pcs.	66 bd. ft.	.24	15.84
1 x 4 x 12′ No. 1 WP	8-12	1 pc.	4 bd. ft.	.24	.96
½ x 6 wood screws	8-25	1 gross		.90	.90
¾ x 6 wood screws	8-25	1 gross		.80	.80
1 x 8 x 8′ DWP	8-25	1 pc.	5 bd. ft.	.35	1.75
Total material					174.20
Total labor and material					345.03

Component 18.—Painting

Painting was scheduled in two parts by the painting subcontractor. The first coat of primer was put on the exterior just as soon as the house was enclosed and the garage erected. The structure was left to stand until the rough grading was completed on the outside and all of the carpentry work on the inside.

At this point the subcontractor returned his crew to the job and put on the second exterior coat. Moving to the inside of the house, the crew applied two coats of rubber-base paint to all surfaces, including the free-standing closet units, to complete the job. No interference was experienced by the painting crew from the other trades involved in construction of the house.

Painting was done under a subcontract. The amount of the contract, including labor and material, was $728.00 each, for the two houses.

COMPONENT 18.—PAINTING (HOUSE A)
(House B similar)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Painter, skilled (siding)			18		
Painter, apprentice (siding)			1½		
Painter, skilled (exterior windows)			8		
Painter, skilled (exterior trim)			15¼		
Painter, apprentice (exterior trim)			21¾		
Painter, skilled (walls, ceiling, interior partitions)			48¾		
Painter, skilled (doors)			23		
Painter, apprentice (doors)			1¼		
Painter, skilled (interior windows and trim)			8		
Painter, apprentice (interior windows and trim)			6¾		

COMPONENT 18.—PAINTING (HOUSE A)—Continued
(House B similar)

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Painter, skilled (kitchen cabinets)	-----	----------	4	------	------
Painter, skilled (garage)	-----	----------	6	------	------
Painter, apprentice (garage)	-----	----------	½	------	------
Painter, skilled (louvers)	-----	----------	1¼	------	------
Painter, apprentice (louvers)	-----	----------	1	------	------
Painter, skilled (free standing units)	-----	----------	15½	------	------
Painter (tile on bathroom walls, 140 sq. ft.)	-----	----------	9	------	------
Total labor	-----	----------		------	------

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
Total subcontract	-----	----------	----------	------	$728.00
Labor and material. Two coats of paint applied on both exterior and interior, and bath tile.					
Total material	-----	----------	----------	------	------
Total labor and material	-----	----------	----------	------	$728.00

Component 19.—Flue (Prefabricated)

As the roofing was being applied, one carpenter was put to work installing the prefabricated flue which was hung on the bottom chords of two trusses. He extended the sections through the sheathing at this time to avoid a future flashing problem.

COMPONENT 19.—FLUE (PREFABRICATED)
(HOUSE A)

A.—TOTAL TIME FOR INSTALLING FLUE

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, foreman	7-2	1	2¾	$2.75	$7.56
Moving flue installed in wrong position:					
Carpenter, skilled	7-2	1	1	2.50	2.50
Laborer, unskilled	7-2	1	2¼	1.85	4.16
Carpenter, foreman	7-7	1	1	2.75	2.75
Carpenter, foreman	7-14	1	2	2.75	5.50
Carpenter, skilled	7-14	3	4	2.50	10.00
Laborer, unskilled	7-14	1	2	1.85	3.70
Carpenter, foreman	7-17	1	1¼	2.75	3.44
Laborer, unskilled	7-17	1	½	1.85	.93
Carpenter, foreman	7-18	1	¼	2.75	.69
Total labor	-----	----------	----------	------	41.23

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
24" flue sections	7-2	3 pcs.	3 pcs.	$8.00	$24.00
3" aluminum housing flashing.	7-2	1 pc.	----------	------	12.00
14½" support carton	7-2	1 pc.	----------	------	13.00
Housing cap carton	7-2	1 pc.	----------	------	5.00
Refractory casing	7-2	1 pc.	----------	------	5.00
1' flue section	7-3	1	----------	------	5.00
Total material	-----	----------	----------	------	64.00
Total labor and material	-----	----------	----------	------	105.23

Component 20.—Plumbing

Like the electrical work, plumbing was a subcontract job; and the scheduling of the work was the main item. As in all jobs, it was impossible for the plumber to complete the work at one time; however, unnecessary trips were eliminated by setting forth specific items that were to be completed at certain stages of the construction. These stages were:

(*a*) As the mason was working on the foundation wall, the plumber was to:

1. Install water service.
2. Run all underfloor water supplies and drains.
3. Install prefabricated soil stack.
4. Install building drain to 5' outside of the foundation wall.
5. Put water pressure on all lines for test purposes.

(*b*) After the floor was poured and walls erected, and while the carpenters were working on the sheathing and roofing, the plumber was to:

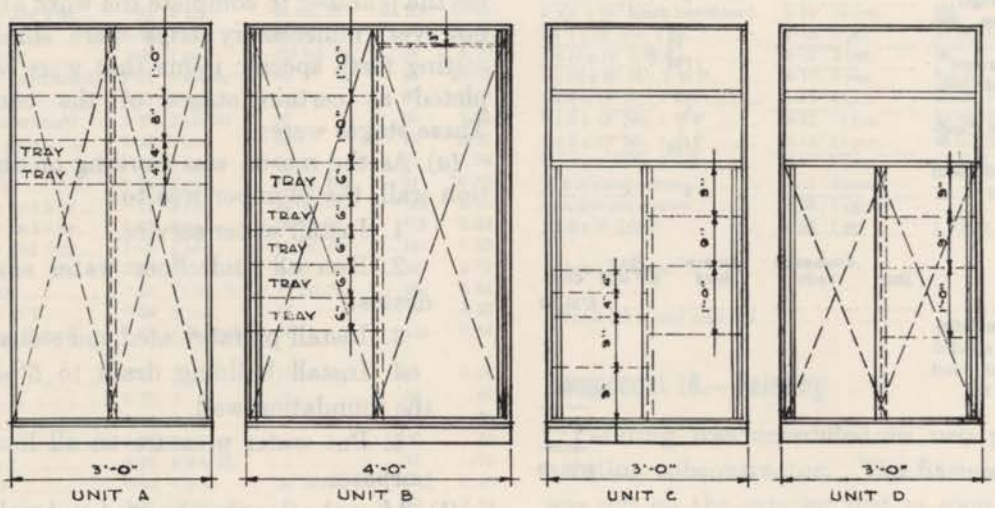
1. Extend the two stack vents through the roof.
2. Rough-in all water supply and drain pipes above finish floor.
3. Set bathtub.

(*c*) As a finishing operation, the plumber made a third trip to set and connect the fixtures, install the hot-water heater, and the water meter.

COMPONENT 20.—PLUMBING (HOUSE A)

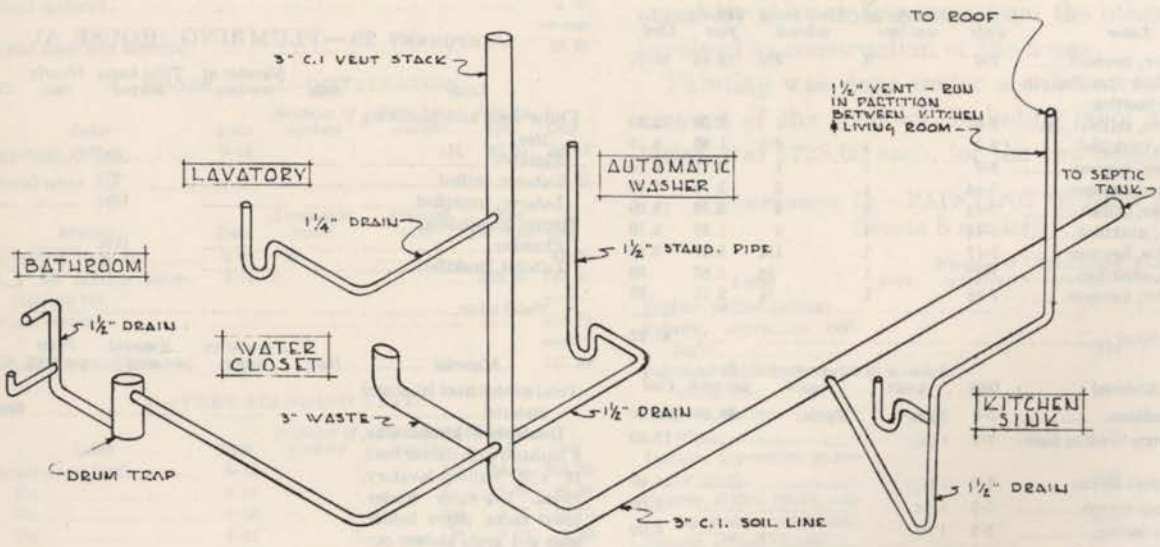
Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Under floor and plumbing tree:					
Plumber	-----	----------	29½	------	------
Laborer, skilled	-----	----------	2½	------	------
Laborer, unskilled	-----	----------	14½	------	------
Fixture installation:					
Plumber	-----	----------	19¾	------	------
Laborer, unskilled	-----	----------	¾	------	------
Total labor	-----	----------	----------	------	------

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
Total subcontract labor and material	-----	----------	----------	------	$960.50
Double bowl kitchen sink, 5' bathtub with shower head, 19" x 21" built-in lavatory, 52-gal. hot-water heater, towel racks, paper holder, soap and grab, shower curtain road, water closet.					
Total material	-----	----------	----------	------	------
Total labor and material	-----	----------	----------	------	960.50



PLAY AREA ELEVATION

FIGURE 54 (*above*).—*Storage units—play area elevation and* FIGURE 55 (*below*).



PLUMBING DIAGRAM
NO SCALE

Component 21.—Heating

Heating was also done under a subcontract. The furnace installed was a counter-flow, pot-type oil-fired furnace with a 64,000 B. t. u. rating. The 275-gallon underground storage tank was placed on the kitchen side of the house with the oil line coming in through the foundation wall and under the concrete slab. The amount of the subcontract, including labor and material, was $596.70 for each of the two demonstration houses.

COMPONENT 21.—HEATING (HOUSE A)
(House B similar)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Installing above ground duct work:					
Metal worker	-----	-----	8½	-----	-----
Carpenter, foreman	-----	-----	1	-----	-----
Carpenter	-----	-----	½	-----	-----
Laborer, unskilled	-----	-----	½	-----	-----
Installing furnace, oil tank, etc.:					
Metal worker	-----	-----	8¾	-----	-----
Total labor (included in subcontract)	-----	-----	-----	-----	-----

Material	Date	Amount in units	Amount used	Price per unit	Cost
Total subcontract	-----	-----	-----	-----	$596.70
Includes labor and material. Heating unit used was an oil fired, pot type, counter flow, warm air furnace with a B. t. u. rating of 64,000.					
Total material	-----	-----	-----	-----	-----
Total labor and material	-----	-----	-----	-----	596.70

Component 22.—Garages

The wall sections of the garage were fabricated on the floor slab and tipped into place, in the same fashion as described under Component 6—Exterior Walls.

COMPONENT 22.—GARAGES (HOUSE A)

A.—FLOOR

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Foreman	6-4	1	2½	$1.50	$3.75
Helpers	6-4	2	5	1.50	7.50
Laborer, unskilled	6-5	2	3	1.85	5.55
Do	6-6	2	10¼	1.85	18.96
Foreman	6-6	1	4	1.85	7.40
Laborer, unskilled	6-7	1	1½	1.85	2.78
Laborer, skilled	6-9	1	2	2.00	4.00
Mason, skilled	6-9	1	2	3.25	6.50
Laborer, skilled	6-10	1	8	2.00	16.00
Mason	6-10	1	8	3.25	26.00
Laborer, unskilled	6-11	5	2½	1.85	4.63
Do	6-12	4	4¾	1.85	8.79
Laborer, skilled	6-13	1	¾	2.00	1.50
Mason	6-13	1	¾	3.25	2.44
Laborer, unskilled	6-14	2	1	1.85	1.85
Do	6-16	2	1½	1.85	2.78
Do	6-17	3	6¼	1.85	11.56

COMPONENT 22.—GARAGES (HOUSE A)—Continued

A.—FLOOR—Continued

Labor	Late	Number of workers	Total hours worked	Hourly rate	Cost
Cement finisher, skilled	6-17	2	4¾	2.75	13.07
Cement finisher, apprentice	6-17	4	9½	2.00	19.00
Cement finisher, skilled (overtime)	6-17	1	1½	4.13	6.20
Total labor	-----	-----	-----	-----	170.26

Material	Date	Amount in units	Amount used	Price per unit	Cost
Concrete blocks 8 x 8 x 16	6-6	227	227	$0.205	$46.54
Mortar	6-6	3 sacks	3 sacks	1.07	3.21
Concrete 1-3-5	6-6	11070#	2.77 cu. yds.	12.10	33.52
Fine sand	6-6	1910#	0.96 cu. yd.	3.40	3.26
Concrete blocks 4 x 8 x 16	6-6	52	52	.175	9.10
Mortar	6-9	10 sacks	10 sacks	1.07	10.70
Pit run gravel	6-11	15 cu. yds.	15 cu. yds.	1.60	24.00
Cement	6-17	1 sack	1 sack	1.30	1.30
Concrete 1-3-5	6-17	8360#	2.09 cu. yds.	12.10	25.29
Do	6-17	6010#	1.50 cu. yds.	12.10	18.15
Total material	-----	-----	-----	-----	175.07
Total labor and material	-----	-----	-----	-----	345.33

B.—WALLS 0.—PRECUTTING FRAMING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-2	1	½	$2.50	$1.25
Carpenter, unskilled	7-2	1	½	1.75	.88
Carpenter, foreman	7-7	1	¼	2.75	.69
Carpenter, skilled	7-7	2	1½	2.50	3.75
Laborer, unskilled	7-7	2	1¼	1.85	2.31
Total labor	-----	-----	-----	-----	8.88
Total material	-----	-----	-----	-----	None
Total labor and material	-----	-----	-----	-----	8.88

B.—WALLS 1.—LAYOUT AND FRAMING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-2	1	1¼	$2.75	$3.44
Carpenter, skilled	7-2	1	1	2.50	2.50
Carpenter, foreman	7-7	1	¾	2.75	2.06
Carpenter, skilled	7-7	2	½	2.50	1.25
Carpenter, foreman	7-8	1	¾	2.75	2.06
Carpenter, skilled	7-8	3	1½	2.50	3.75
Laborer, unskilled	7-8	1	½	1.85	.93
Carpenter, skilled	7-10	1	1¼	2.50	3.13
Carpenter, foreman	7-10	1	¾	2.75	2.06
Carpenter, foreman	7-11	1	22¼	2.75	6.19
Carpenter, skilled	7-11	1	2¼	2.50	5.63
Carpenter, foreman	7-14	1	½	2.75	1.38
Carpenter, skilled	7-14	1	1½	2.50	3.75
Total labor	-----	-----	-----	-----	38.13

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12' No. 1 and 2 fir	7-1	6 pcs.	48 bd. ft.	$0.145	$6.96
2 x 4 x 16' No. 1 and 2 fir	7-2	7 pcs.	75 bd. ft.	.145	10.88
2 x 4 x 14' No. 1 and 2 fir	7-2	26 pcs.	243 bd. ft.	.145	35.24
2 x 4 x 12' No. 1 and 2 fir	7-2	10 pcs.	80 bd. ft.	.145	11.60
Stran steel perforated channel.	6-30	1 pc.	12' 6"	.30	3.75
2 x 4 x 16' No. 1 and 2 fir	7-14	7 pcs.	75 bd. ft.	.145	10.88
Total material	-----	-----	-----	-----	79.31
Total labor and material	-----	-----	-----	-----	117.44

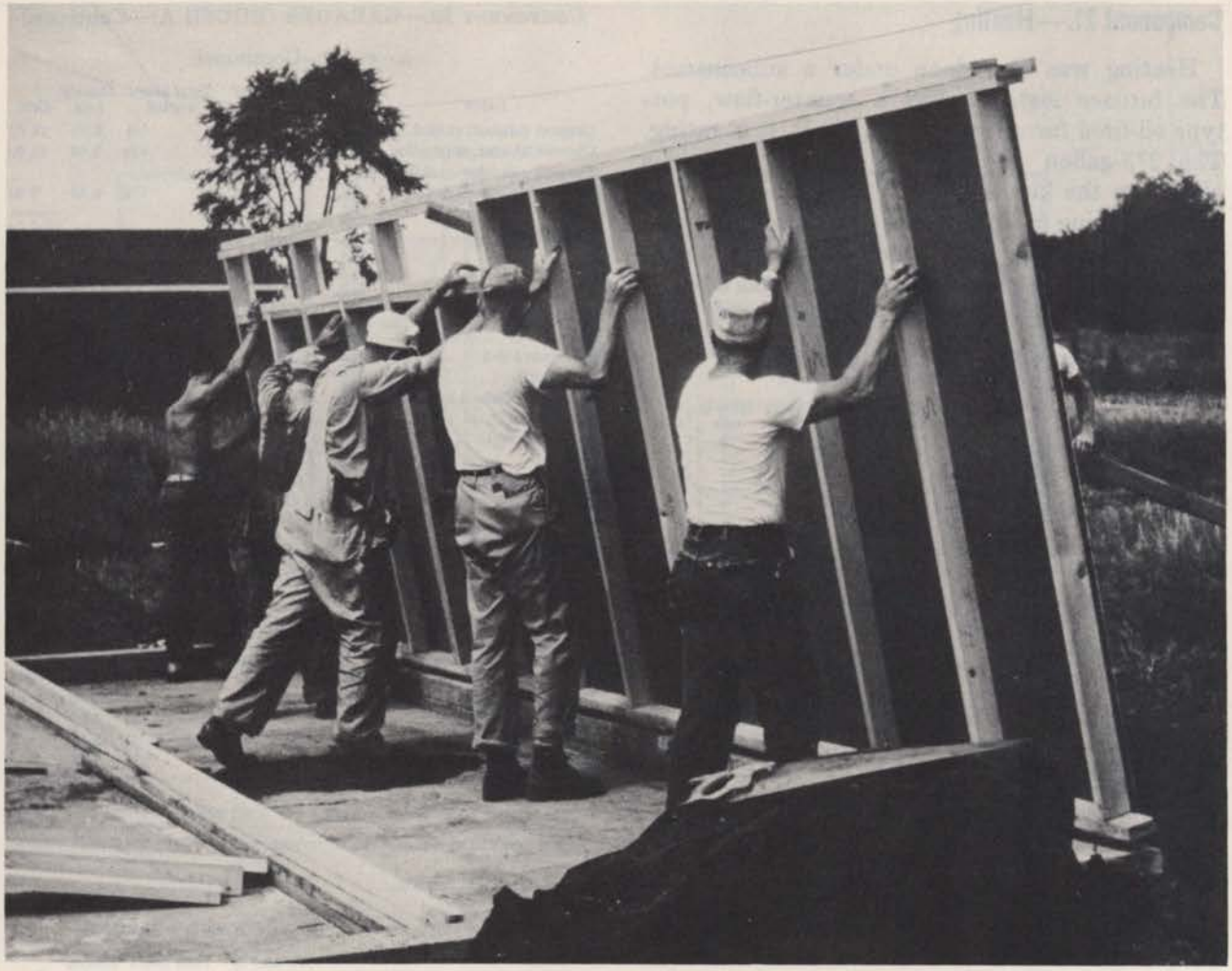


FIGURE 56.—*Wall sections are preassembled on the floor slab and are then tipped into place.*

COMPONENT 22.—GARAGES (HOUSE A)—Continued

B.—WALLS 2.—NAILING OF SHEATHING

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, foreman	7-2	1	½	$2.75	$1.38
Carpenter, skilled	7-2	1	¾	2.50	1.88
Laborer, unskilled	7-2	1	¼	1.85	.46
Carpenter, foreman	7-7	1	¼	2.75	.69
Carpenter, skilled	7-7	2	1	2.50	2.50
Do	7-8	2	1	2.50	2.50
Laborer, unskilled	7-8	1	¼	1.85	.46
Total labor					9.87

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
4′ x 8′ x 25/32 sheathing	7-2	15 sheets	480 sq. ft.	$0.12	$57.60
Total material					57.60
Total labor and material					67.47

COMPONENT 22.—GARAGES (HOUSE A)—Continued

B.—WALLS 3.—FLASHING SILLS AND TRIM

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, skilled	7-7	3	1	$2.50	$2.50
Carpenter, foreman	7-8	1	1¾	2.75	4.81
Carpenter, skilled	7-8	1	¼	2.50	.63
Total labor					7.94

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
1″ x 6″ x 16′ No. 1 W. P	7-2	4 pcs.	0.32 bd. ft.	$0.24	$7.68
1″ x 8″ x 8′ C. V. G. fir	7-2	4 pcs.	21 bd. ft.	.34	7.14
1 x 6 x 8′ C. V. G. fir	7-2	4 pcs.	16 bd. ft.	.34	5.44
1 x 6 x 8′ No. 1 W. P	7-2	1 pc.	4 bd. ft.	.24	.96
Total material					21.22
Total labor and material					29.16

B.—WALLS 4.—SIDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-2	2	1	$2.50	$2.50
Laborer, unskilled	7-2	1	¼	1.85	.46
Carpenter, foreman	7-7	1	1	2.75	2.75
Carpenter, skilled	7-7	3	4	2.50	10.00
Laborer, unskilled	7-7	1	¾	1.85	1.39
Carpenter, foreman	7-8	1	1½	2.75	4.12
Carpenter, skilled	7-8	2	3½	2.50	8.75
Laborer, unskilled	7-8	1	½	1.85	.93
Carpenter, skilled	7-15	1	2	2.50	5.00
Total labor					35.90

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 8 x 5/16" Asbestos Cement	7-2	15	480 sq. ft.	$0.115	$55.20
Total material					55.20
Total labor and material					91.10

B.—WALLS 5.—ERECTION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-7	1	¼	$2.75	$0.69
Carpenter, skilled	7-7	2	½	2.50	1.25
Laborer, unskilled	7-7	1	¼	1.85	.46
Carpenter, foreman	7-8	1	¾	2.75	2.06
Carpenter, skilled	7-8	2	1½	2.50	3.75
Laborer, unskilled	7-8	1	1¼	1.85	2.31
Carpenter, foreman	7-9	1	1	2.75	2.75
Carpenter, skilled	7-9	2	½	2.50	1.25
Laborer, unskilled	7-9	1	1	1.85	1.85
Total labor					16.37
Total material					None
Total labor and material					16.37

C.—ROOF (INCLUDING CEILING JOIST, BUILT-UP ROOF, TRIM FOR ROOF)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-8	2	1¼	$2.50	$3.13
Carpenter, foreman	7-9	1	3¾	2.75	10.31
Carpenter, skilled	7-9	2	13½	2.50	33.75
Laborer, unskilled	7-9	1	6½	1.85	12.03
Carpenter, foreman	7-10	1	5¼	2.75	14.44
Carpenter, skilled	7-10	2	7¼	2.50	18.13
Laborer, unskilled	7-10	1	7½	1.85	13.89
Carpenter, foreman	7-11	1	3½	2.75	9.63
Carpenter, skilled	7-11	2	4¼	2.50	10.63
Laborer, unskilled	7-11	1	2¾	1.85	5.09
Carpenter, skilled	7-14	3	13½	2.50	33.75
Do	7-16	1	2	2.50	5.00
Laborer, unskilled	7-17	1	¼	1.85	.46
Carpenter, foreman	7-18	1	3¾	2.75	10.31
Carpenter, skilled	7-18	2	7½	2.50	18.75
Laborer, unskilled	7-18	1	5¾	1.85	10.64
Total labor					209.94

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 10' T. & G. Y. P.	7-2	197 pcs.	985	$0.135	$126.90
15# felt	7-2	1 roll	1 roll	3.70	3.70
2 x 8 x 16' No. 1 and 2 fir	7-2	14 pcs.	299 bd. ft.	.145	43.36
2 x 8 x 12' No. 1 and 2 fir	7-2	13 pcs.	208 bd. ft.	.145	30.16
4 x 4 x 10' No. 1 and 2 fir	7-2	1 pc.	13 bd. ft.	.15	1.96
2 x 8 x 14' No. 1 and 2 fir	7-9	1 pc.	19 bd. ft.	.145	2.76
2 x 8 x 16' No. 1 and 2 fir	7-10	1 pc.	21 bd. ft.	.145	3.05
15# felt	7-10	1 roll	1 roll	3.70	3.70
1 x 10 x 8' C. V. G. fir	7-10	1 pc.	7 bd. ft.	.34	2.38
1 x 10 x 14' C. V. G. fir	7-10	4 pcs.	47 bd. ft.	.34	15.98

C.—ROOF (INCLUDING CEILING JOIST, BUILT-UP ROOF, TRIM FOR ROOF)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 10 x 12' C. V. G. fir	7-10	2 pcs.	20 bd. ft.	$0.34	$6.80
Style D. galvanized starter strip.	7-10	90 lin. ft.	90 lin. ft.	.09	8.10
1 x 8 x 14' Std. S/L	7-10	25 pcs.	233 bd. ft.	.135	25.11
2 x 4 x 16' No. 1 and 2 fir	7-14	2 pcs.	21 bd. ft.	.145	3.05
¾" quarter round 15/14. 1/15.	7-16	80 lin. ft.	80 lin. ft.	.04	3.20
1 x 8 x 12' std. S/L	7-10	24 pcs.	192 bd. ft.	.135	25.92
19" selvage—split sheet—black.	8-13	14 rolls		2.85	31.35
Total material					337.48
Total labor and material					547.42

D.—DOORS AND WINDOWS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-11	1	¾	$2.50	$1.88
Do	7-15	1	1	2.50	2.50
Do	7-16	1	2	2.50	5.00
Subcontracted:					
Glaziers, skilled	7-16	1	¼		
Glazier, apprentice	7-16	1	¼		
Carpenter, skilled	7-17	2	1¾	2.50	4.38
Total labor					13.76

Material	Date	Amount in units	Amount used	Price per unit	Cost
Lockwood key and knob	7-16	1			$5.40
D. B. butt 3½"	7-16	1½ pr.		$0.88	1.32
Total material					6.72
Total labor and material					20.48

Component 23.—Walks and Drives

After the house had been laid out, one of the first operations was to establish the lines of the driveway and to fill this area with pit-run gravel. This facilitated the delivery of material in cases of inclement weather and provided a walkway. After the structure had been completed and before landscaping was started, retainer boards were put in and white crushed rock spread as the finish material for the drive.

The work showed that there were big advantages in pouring steps and walks at the same time that the garage slab was poured, instead of as a finishing operation. Since it was necessary to have a concrete finisher on the job during all pouring operations, his work was scheduled so that his maximum efforts could be utilized and his work completed during normal working hours. Since the house slab was poured in one operation, the garage floor, walks, and steps were poured the following day. The garage floor was scheduled as the first operation so that the carpenter could have ample time to put down the forms for the walks and the

cement finisher could have a full eight hours of work.

By carrying on these operations during the early stages of construction, several benefits were obtained. Walks were used for temporary storage areas; cutting tables were set alongside of the walks, thus giving the workmen an ideal work space; and the walks proved helpful in cutting down on the amount of mud usually tracked into a structure.

To eliminate any possible sagging of the steps or pulling away from the foundation walls, post holes 8″ in diameter and down to the footings were poured at each corner of the exterior edges of the steps.

COMPONENT 23.—WALKS AND DRIVES (HOUSE A)

A.—WALKS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	8-12	1	3¼	$1.85	$6.01
Total labor					6.01

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12′ No. 1 and 2 fir	7-14	3 pcs.	24 bd.-ft.	$0.145	$3.48
Total material					3.48
Total labor and material					9.49

B—DRIVES

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-30	1	6	$1.85	$11.10
Do	7-11	1	3½	1.85	6.48
Do	8-14	1	½	1.85	.93
Do	8-29	1	½	1.50	.75
Total labor					19.26

Material	Date	Amount in units	Amount used	Price per unit	Cost
8″ diameter 3′ long drive tile	6-10	5 pcs.	15 lin. ft.	$1.05	$15.75
Gravel	6-12	15 yds.	15 yds.	1.60	24.00
Do	6-13	10 yds.	10 yds.	1.60	16.00
Do	6-30	15 yds.	15 yds.	1.60	24.00
Do	6-28	10 yds.	10 yds.	1.60	16.00
White Rock—Class No. 8 road compress	8-29	1 load	7 yds.	2.90	20.30
Total material					116.05
Total labor and material					135.31

C.—STOOPS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-19	1	2¼	$1.85	$4.16
Carpenter, skilled	6-19	1	5	2.50	12.50
Laborer, unskilled	6-20	2	2	1.85	3.70
Cement finisher, skilled	6-20	1	1¼	2.75	3.44
Cement finisher, unskilled	6-20	1	¾	2.00	1.50
Carpenter, skilled	9-3	1	3½	2.50	8.75
Total labor					34.05

COMPONENT 23.—WALK AND DRIVES (HOUSE A)—Continued

C.—STOOPS—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 8 x 12′ No. 1 and 2 fir	6-19	2 pcs.	32 bd.-ft.	$0.145	$4.64
2 x 8 x 14′ No. 1 and 2 fir	6-19	2 pcs.	37 bd.-ft.	.145	5.37
1-3-5 concrete	6-20	7700#	1.92 cu. yd.	12.10	23.23
2 x 4 x 7′—8″ No. 1 and 2 fir	8-29	7 pcs.	37 bd. ft.	.145	5.36
2 x 4 x 10′ No. 1 and 2 fir	9-3	1 pc.	7 bd. ft.	.145	1.02
Total material					39.62
Total labor and material					73.67

E.—FENCE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-23	2	5½	$2.50	$13.75
Laborer, unskilled	7-23	1	5¾	1.85	10.64
Carpenter, foreman	7-23	1	4¼	2.75	11.69
Do	7-24	1	2½	2.75	6.88
Carpenter, skilled	7-24	1	2½	2.50	6.25
Laborer, unskilled	7-24	1	2	1.85	3.70
Do	7-25	1	¼	1.85	.46
Painter, apprentice	8-11	2	4	1.50	6.00
Do	8-16	2	5¾	1.50	8.63
Total labor					68.00

Material	Date	Amount in units	Amount used	Price per unit	Cost
4′x 8′x ⅛″ temp. hardboard	7-23	5 sheets	160	$0.11	$17.60
4 x 4 x 14′ No. 1 and 2 fir	7-23	1 pc.	19 bd.-ft.	.150	2.85
2 x 4 x 16′ No. 1 and 2 fir	7-23	2 pcs.	21 bd.-ft.	.145	3.05
2 x 6 x 14′ No. 1 and 2 fir	7-23	1 pc.	14 bd.-ft.	.145	2.03
2 x 4 x 12′ No. 1 and 2 fir	7-23	7 pcs.	56 bd.-ft.	.145	8.12
2 x 4 x 16′ No. 1 and 2 fir	7-23	11 pcs.	117 bd.-ft.	.145	13.92
2 x 6 x 14′ No. 1 and 2 fir	7-23	1 pc.	14 bd.-ft.	.145	2.03
2 x 6 x 16′ No. 1 and 2 fir	7-23	1 pc.	16 bd.-ft.	.145	2.32
½″ x 6 bolts	7-23	24		.10	2.40
Total material					54.32
Total labor and material					122.32

Component 24.—Rough Grading

COMPONENT 24.—ROUGH GRADING (HOUSE A)

A.—ROUGH

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Machine operator and machine	7-7	1	4	$6.00	$24.00
Laborer, unskilled	7-8	1	2½	1.85	4.63
Machine operator and machine	7-12	1	2½	6.00	15.00
Laborer, unskilled	8-20	1	½	1.50	.75
Machine operator and machine	8-21	1	¾	6.00	4.50
Total labor					48.88

Material	Date	Amount in units	Amount used	Price per unit	Cost
Earth	6-27	32 loads		$1.00	$32.00
Total material					32.00
Total labor and material					80.88

COMPONENT 24.—ROUGH GRADING (HOUSE A)—Con.

B.—FINISH (INCLUDING SEEDING)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Machine operator and machine	8-21	1	1½	$5.00	$7.50
Do	8-22	1	3	5.00	15.00
Laborer, unskilled	8-25	1	2½	1.50	3.75
Do	8-23	2	8¾	1.50	13.13
Machine operator and machine	8-23	1	1¼	5.00	6.25
Total labor					45.63

Material	Date	Amount in units	Amount used	Price per unit	Cost
Blended grass seed	8-23	1 sac-25#		$17.50	$17.50
Fertilizer	8-23	1 sac-100#		3.25	3.25
Total material					20.75
Total labor and material					66.38

Component 26.—Bath Tile

This component was considered as one of the finishing operations. After all of the plumbing lines had been extended to the outside of the partitions and the wallboard was in place, the tile was set by the painting subcontractor. The walls were sealed with a primer sealer; the mastic applied with a toothed trowel, and the tile set according to the manufacturer's directions.

This operation has no particular sequence in the house-building program; however, it must be completed prior to the final trip to the job by the plumber and before interior decoration begins.

The tile setting was included in the painting subcontract which covered the cost of furnishing and setting the tile except for an expenditure of $1.20 for extra tile.

Component 27.—Storm Windows

One of the last operations to be completed was the installation of the storm windows. All of the frames were precut and grooved on the power saw. Each window was then treated individually as the frames were made. The four corners were fastened together with L angles on the exterior side. After completion the frames were removed, glazed, using rubber tubing, and reset into the window opening. Metal clips were used to hold the window in place.

COMPONENT 27.—STORM WINDOWS (HOUSE A)

A.—PRECUTTING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-29	1	3	$2.60	$7.80
Do	9-30	1	1½	2.60	3.90
Total labor					11.70

COMPONENT 27.—STORM WINDOWS (HOUSE A)—Con.

A.—PRECUTTING—Continued

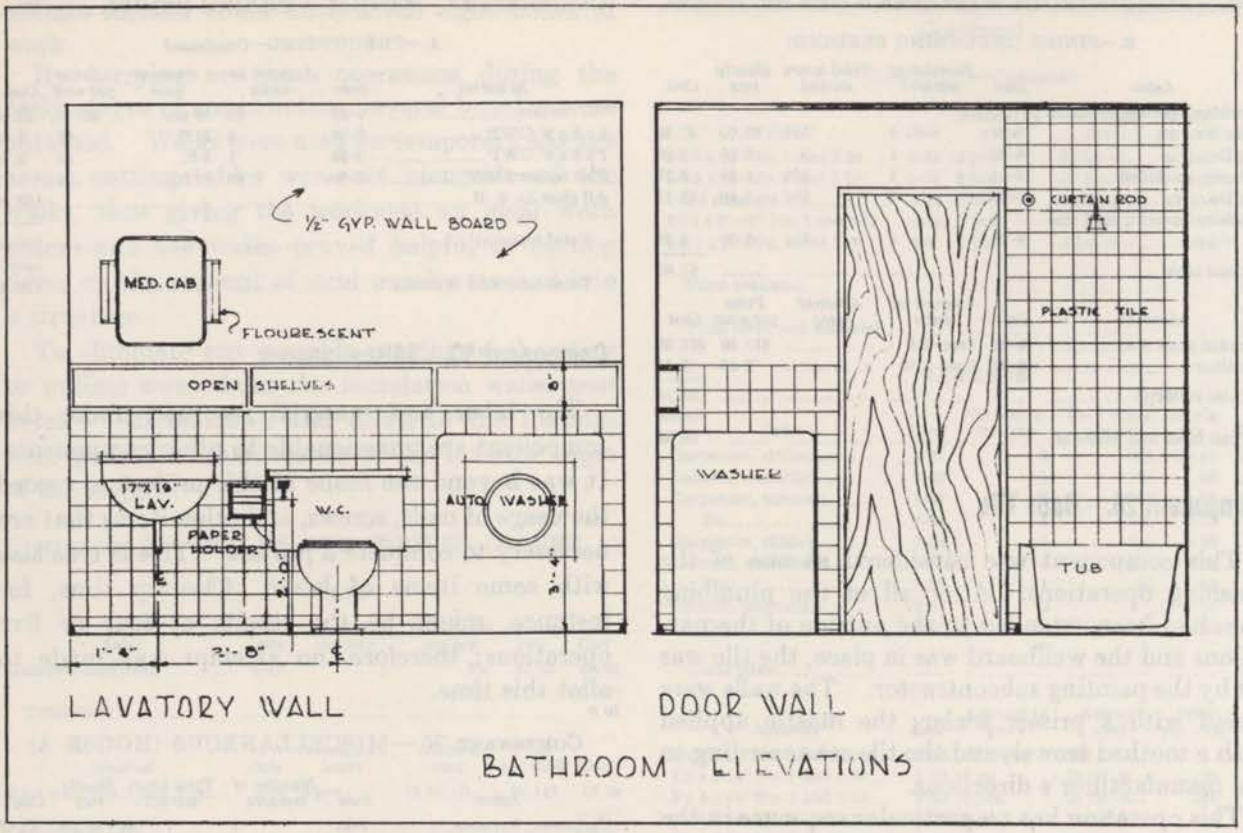
Material	Date	Amount in units	Amount used	Price per unit	Cost
"L" braces	9-26	56	56 pcs.	$0.04	$2.24
1 x 8 x 8′ CWP	9-26	4	21 ft.	.45	9.45
1 x 8 x 8′ CWP	9-30	1	5 ft.	.45	2.25
Flat corner JMN	9-30	18	18 ft.	.04	.72
All glass D. S. B.					102.00
Total material					116.66
Total labor and material					128.36

Component 30.—Miscellaneous

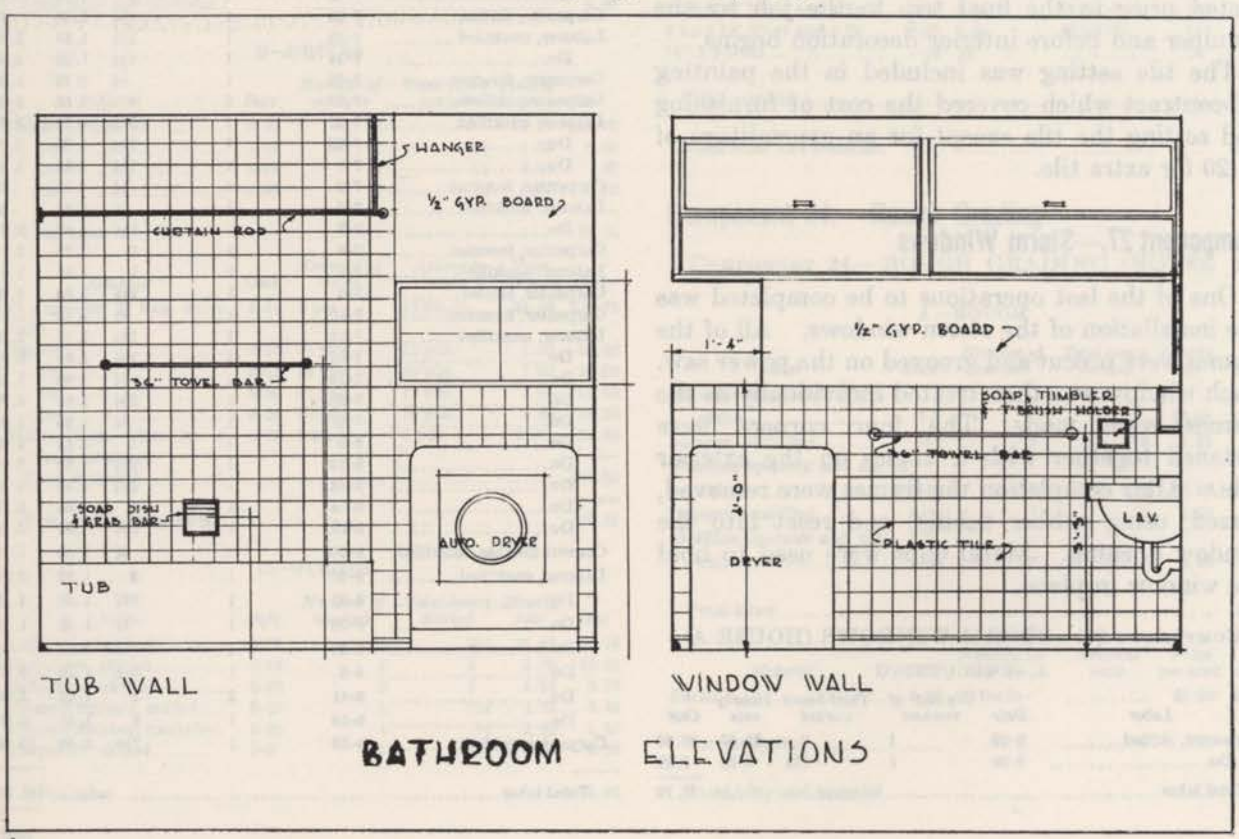
The labor and material recorded under this component are unassignable to other components. It was beyond the scope of this project to record the usage of nails, screws, and other items that are necessary to complete a project. This is true also with some items of labor. Cleanup time, for instance, might be the results of four or five operations; therefore, no attempt was made to allot this time.

COMPONENT 30.—MISCELLANEOUS (HOUSE A)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-18	1	¾	$2.75	$2.06
Laborer, unskilled	7-18	1	1¼	1.85	2.31
Do	7-22	1	4	1.85	7.40
Carpenter, skilled	7-23	1	¼	2.50	.63
Laborer, unskilled	7-23	1	1½	1.85	2.78
Do	7-24	1	2½	1.85	4.63
Carpenter, foreman	7-25	1	½	2.75	1.38
Carpenter, skilled	7-25	2	2	2.50	5.00
Laborer, unskilled	7-25	1	1½	1.85	2.78
Do	7-28	1	1½	1.85	2.78
Do	7-1	1	1¼	1.85	2.31
Carpenter, foreman	7-2	1	¼	2.75	.69
Laborer, unskilled	7-2	1	¼	1.85	.46
Do	7-7	1	1¼	1.85	2.31
Carpenter, foreman	7-8	1	1	2.75	2.75
Laborer, unskilled	7-8	1	1	1.85	1.85
Carpenter, skilled	7-9	1	2¼	2.50	5.63
Carpenter, foreman	7-10	1	½	2.75	1.38
Laborer, unskilled	7-14	1	1½	1.85	2.78
Do	7-16	1	1¾	1.85	3.24
Do	7-29	1	¾	1.85	1.39
Do	7-30	1	3¾	1.85	6.94
Do	7-31	1	¾	1.85	1.39
Do	8-8	1	1	1.85	1.85
Do	8-12	1	3¾	1.85	6.94
Do	8-13	1	1¼	1.85	2.31
Do	8-14	1	2	1.85	3.70
Do	8-19	1	2¼	1.50	3.38
Cement finisher, unskilled	8-20	1	¾	1.50	1.13
Laborer, unskilled	8-25	1	2	1.50	3.00
Do	8-27	1	2¾	1.50	4.13
Do	8-28	1	¾	1.50	1.13
Do	8-29	1	¼	1.50	.38
Do	9-8	1	6½	1.50	9.75
Do	9-11	2	2	1.50	3.00
Do	9-19	1	4	1.50	6.00
Carpenter, skilled	9-23	1	7½	2.60	19.50
Total labor					131.07



FIGURES 57 *(above)* and 58 *(below)*.



COMPONENT 30.—MISCELLANEOUS (HOUSE A)—Con.

Material	Date	Amount in units	Amount used	Price per unit	Cost
8d common nails	7-10	1 keg			$9.03
8d finish nails	7-11	2—10# ctn.	20#	$1.40	2.80
2 x 8 x 18' A. D. hemlock	7-14	6 pcs.	144 bd. ft.	.14	20.16
1 x 4 x 12' C. F.	7-14	6 pcs.	24 bd. ft.	.34	8.16
2 x 4 x 16' No. 1 and 2 fir	7-14	2 pcs.	21 bd. ft.	.145	3.05
1 x 8 x 8' CVG fir	7-14	1 pc.	5 bd. ft.	.34	1.70
2 x 4 x 12' No. 1 and 2 fir	7-23	1 pc.	8 bd. ft.	.145	1.16
16d finish nails	7-23	10#	10#	.14	1.40
10d finish nails	7-23	10#	10#	.14	1.40
6d finish nails	7-23	10#	10#	.14	1.40
16d finish nails	6-21	5#	5#	.14	.70
Outside white paint	6-24	1 gal.	1 gal.	5.80	5.80
10d finish nails	6-24	5#	5#	.14	.70
4d galvanized nails	6-24	5#	5#	.16	.80
Sanding belts	6-26	6	6		1.80
No. 2 R. C. shingles	6-26	1 bundle	1 bundle	3.25	3.25
No. 1½ galvanized RFG nails.	6-26	5#	5#	.20	1.00
10d finish nails	6-26	10#	10#	.14	1.40
10d common nails	6-27	1 keg	100#	10.48	10.48
8d common nails	6-27	1 keg	100#	10.48	10.48
3d galvanized shingle nails	6-30	5#	5#	.20	1.00
8d finish nails	7-1	5#	5#	.14	.70
10# ctns. roofing nails	7-1	2—10# ctns.	20#	2.00	4.00
1 x 6 x 12—S4S Std	7-1	13 pcs.	78 bd. ft.	.135	10.53

COMPONENT 30.—MISCELLANEOUS (HOUSE A)—Con.

Material	Date	Amount in units	Amount used	Price per unit	Cost
1½ galvanized roofing nails	7-2	5#	5#		$1.10
No. 115 garbage rec	6-19	1	1	$13.80	13.80
4d finish nails	7-9	2 pkgs.	2 pkgs.	.17	.34
3' Kraft paper	6-24	1 roll		.02	10.00
1 x 6 x 12' No. 1 W. P.	7-31	8 pcs.	48 bd. ft.	.24	11.52
Wood putty	8-11	1 can		.85	.85
Wire nails	8-11	2 ctns.		.12	.24
6d finish nails	8-13	10#	10#	.14	1.40
8d finish nails	8-13	10#	10#	.14	1.40
Tacks	8-14	1 box			.40
1½ x 6 wood screws	8-14	1 gross			1.50
1¼ x 5 wood screws	8-14	1 gross			1.42
Pilaster strips	8-18	8 LF		.10	.80
Brads	8-22	2 boxes		.12	.24
Power—monthly charge	8-4				1.70
Yellow lumber crayons	8-26	2	2	.15	.30
Floor wax	9-19	1 gal.		3.25	3.25
Floor sealer	9-19	1 gal.		5.25	5.25
Bolts and washers	9-19	10		.03	.30
Red resin paper	9-20	1 roll		2.70	2.70
Total material					161.41
Total labor and material					292.48

PART IV

Waste Study—House A

Since one of the primary objectives of the research was to demonstrate that proper planning and construction techniques could reduce material and labor requirements, the subject of waste accumulation during the construction of the houses is pertinent. Table 2 describes the waste, overage, and extra material which had to be ordered during the construction of House A.

TABLE 2.—*Waste study—House A*

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 0.—CONSTRUCTION BUILDINGS.					
Component 1.—EARTH PREPARATION.					
Component 2.—LAYOUT					
Component 3.—EXCAVATION					
Component 4.—FOUNDATION:					
A. Forms					
B. Concrete footings	4 cu. yd. concrete		5.5 cu. yd. concrete	38	Increased size of footing from 8 x 12 to 8 x 16.
C. Foundation block or poured concrete.	294—8 x 8 x 16 blocks		298—8 x 8 x 16 blocks	1	Surplus order to anticipate breakage.
	98—4 x 8 x 16 blocks		98—4 x 8 x 16 blocks		
	98—4 x 8 x 16 precast caps		119—4 x 8 x 12 precast caps		Changed size of precast caps from 4 x 8 x 16 to 4 x 8 x 12. Used 11 bags cement, 1.51 yd. pea gravel, 3.7 yd. sand.
			10 bags mortar		Required in order to set the concrete blocks.
D. Insulation	192 sq. ft.		256 sq. ft.	33	It was necessary to increase the depth of insulation from 18" to 24" because material available only in 12" widths.
E. Termite shield	120 lin. ft. 10" copper-coated kraft paper.		120 lin. ft. 10" copper-coated kraft paper.		
F. Anchor bolts	16—½" x 12" bolts		20—½ x 10 bolts		12" bolts too long. More bolts were required due to building in sections.
			10—washers		
G. Sills					
Component 5.—FLOOR:					
A. Duct work placing	250 lin. ft. 7" ducts	7	234 lin. ft. 7" ducts		Allowance was made so that pieces could be cut and fitted, also because source of supply was not local.
			3.54 cu. yd. concrete		Tying the ducts down in a wet bed of concrete necessitated this quantity of concrete.
	8—7" 90° ells, 10—7" 2 pc. angles, 1 box ½ x 10 metal screws, 1—sheet metal plenum.				These materials furnished by subcontractor.
	1 roll pressure sensitive tape		1 roll pressure-sensitive tape		
B.1 Earth fill					
B.2 Gravel fill	15 cu. yd. gravel		40 cu. yd. gravel		Original estimate was only tentative. Actual quantity required depended upon house elevation.
C. Vapor barrier	1,500 sq. ft. 8' kraft paper	13	1,200 sq. ft. 8' kraft paper		Original estimate made allowance for overlap. Material came in larger rolls than anticipated.

TABLE 2.—*Waste study—House A*—Continued

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 5.—FLOOR—Con.					
D. Concrete, including wire mesh.	15 cu. yd. concrete		15.6 cu yd. concrete	4	
	1,500 sq. ft. wire mesh	30	1,250 sq. ft. wire mesh		Remaining 250 sq. ft. used on garage slab.
			2—2 x 4 x 18′		Used as screeds.
E. Finish Floor	1024 sq. ft. asphalt tile		990 sq. ft. asphalt tile	3	Bathtub and cabinets space.
Component 6.—EXTERIOR WALLS:					
A. Wall framing	39—2 x 4 x 16′		39—2 x 4 x 16′		Cutting and order schedule shows disposition of these materials.
	1—2 x 4 x 8′		1—2 x 4 x 8′		
	7—2 x 4 x 16′		7—2 x 4 x 16′		
	33—2 x 4 x 18′		33—2 x 4 x 18′		
	1—1 x 4 x 6′		1—1 x 4 x 12′	100	Used as let-in nailer in east wall.
			5—2 x 4 x 16′		Used to replace pieces cut to wrong size, as additional studs as door frames and as top plates.
			2—2 x 4 x 12′		Used as blocking.
			1—2 x 4 x 14′		Used as blocking for vent.
	107.5 lin. ft. stran steel	10	95 lin. ft. stran steel		
			4—Aluminum flashing		Overlooked on estimate.
			5# 1¼″ nails		Used to attach sheathing.
			5# 16d nails		Used to nail framing members together.
			5# 6d finish nails		Used to attach trim.
B. Sheathing	19—4 x 8 x 25/32″		19—4 x 8 x 25/32″		
			2—2 x 8 x 25/32″		Mistake in estimate. 20 sheets required to sheath walls.
C. Building paper					
D. Siding (includes battens and frieze).	19—4 x 8 x ⅜″ asbestos cement		19—4 x 8 x ⅜″ asbestos cement		
			2—4 x 8 x ⅜″ asbestos cement		Mistake in estimating. 21 sheets required to cover walls.
			2—4 x 8 x ⅜″ asbestos cement		To repair broken sheets.
	12—1 x 6 x 8′ battens		12—1 x 6 x 8′		
	1—1 x 6 x 16′ frieze		1—1 x 6 x 16′		
			4—1 x 6 x 8′		
			4—1 x 8 x 8′		Overlooked in estimate.
			1—1 x 6 x 8′		Corner boards.
E. Gable end	4—2 x 6 x 20′		4—2 x 6 x 20′		
	4—2 x 6 x 16′		4—2 x 6 x 16′		
	9—2 x 4 x 12′		2—2 x 4 x 12′		Used wood cut to wrong size from Component 6A.
	4—1 x 2 x 16′		2—1 x 4 x 16′		
	4—1⅛ x 15⅛ x 20′				Changed detail.
	160 sq. ft. 24″ screen				Do.
	384 lin. ft. bevel siding		382 lin. ft. bevel siding		
	5 1⅛ x 6 x 16″ BS				Do.
	1—2 x 8 x 16′		1—2 x 8 x 16′		
	2—2 x 6 x 3′ 6″		1—2 x 6 x 14′		
	4—½ x 4″ bolts w/w		4—½ x 4″ bolts w/w		
	4—2 x 4 x 16′		4—2 x 4 x 16′ galvanized flashing.		Overlooked in estimate.
Component 7.—ROOF FRAMING					
A. Trusses	32—2 x 6 x 20′		32—2 x 6 x 20′		
	32—2 x 6 x 16′		32—2 x 6 x 16′		
	32—1 x 6 x 3′ 6½″		8—1 x 6 x 14′		
	32—1 x 6 x 7′ 5″		32—1 x 6 x 10′		
	32—1 x 6 x 2′				
	16—2 x 6 x 3′ 6″		4—2 x 6 x 14′		
	32—4″ ring connectors		32—4″ ring connectors		
	32—2 x 6 x 1′—3½				From waste.
	32—½ x 4″ bolts w/w		32—½ x 4″ bolts w/w		
C. Sheathing	252—1 x 6 x 12 T/G		252—1 x 6 x 12 T/G		
			13—1 x 6 x 14 T/G	5	Needed so that the joints can be staggered.
			10# tin caps		Overlooked in estimate.
D. Shingles (including starter strip).	1,500 sq. ft. 15# felt	15	2,000 sq. ft. 15# felt	33	The extra quantity was needed to overlap layers of felt.
	14 sqs 19″ selv. roofing	8	15—½ sqs. 19″ selv. roofing	11	Overlap, short rolls, and ridge.
	144 lin. ft. T starter strip		156 lin. ft. T starter strip	8	To eliminate using short pieces.
			30# tin caps		Overlooked in estimate.
			8 cans plastic mastic		
			50# ⅞″ roofing nails		

TABLE 2.—*Waste study—House A*—Continued

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 8.—EXTERIOR TRIM					
A. Soffit	36—1 x 6 x 12′ S/L	3	22—1 x 8 x 12 S/L 12—1 x 8 x 14 S/L	33	Needed more material so joints occurred at a nailing place.
			145 lin. ft. quarter round		Used between soffit and wall.
B. Fascia	6—1 x 4 x 12′	3	6—1 x 4 x 12′ 6—1 x 6 x 12′		The detail was changed.
C. Rake	4—1 x 4 x 20′		4—1 x 4 x 20′		
Component 9.—PARTITIONS	1—2 x 6 x 16′		1—2 x 6 x 16′		
	25—2 x 4 x 16′		25—2 x 4 x 16′		Cutting and order schedule shows disposition of this material.
	4—2 x 4 x 14′		4—2 x 4 x 14′		
	2—2 x 4 x 12′		2—2 x 4 x 12′		
			1—4 x 8 x ⅛″ asbestos cement		Used for furnace room.
			3—2 x 4 x 12′		Blocking.
Component 10.—WINDOWS:					
A. Sill	7—2 x 4 x 12′		8—2 x 4 x 12′	11	Some cut wrong. Short pieces not usable.
C. Stops	250 lin. ft. ½ x ¾		1—1 x 4 x 12′		84 lin. ft. cut from 1 x 4, rest from scrap.
E.1 Inside trim			1 x 6 x 8′		
			7—1 x 6 x 12′		
			7—1 x 6 x 8′		
E.2 Outside trim	10—2 x 4 x 12′		18—2 x 4 x 12′	80	Some pieces were not good enough to be used as trim.
			½ x 10 x 10′		Used around living room windows and for stops.
Component 11.—WIRING					Subcontract.
Component 12.—INSULATION:					
A. Ceiling	900 sq. ft. full thick batts		1,000 sq. ft. full thick batts	10	
B. Side walls	636 sq. ft. semithick batts		636 sq. ft. semithick batts		
Component 13.—WALLBOARD:					
A. Backup					
B. Ceiling	Gypsum wallboard, 15—4 x 12 x ½ FB.		15—4 x 12 x ½ plain		Foilback not available.
	Gypsum wallboard, 8—4 x 10 x ½ FB.		8—4 x 10 x ½ plain		Do.
			25# plasterboard nails		
			5—2 x 4 x 12′		Blocking.
C. Sidewalls	3—4 x 12 x ½ FB		3—4 x 12 x ½ plain		Foilback not available.
	7—4 x 10 x ½ FB		8—4 x 10 x ½ plain		
	10—4 x 8 x ½ FB		8—4 x 8 x ½ plain		
D. Partitions	6—4 x 12 x ½ plain		7—4 x 12 x ½ plain	13	Small pieces, broken pieces, account for additional quantities.
	4—4 x 10 x ½ plain		4—4 x 10 x ½ plain		
	22—4 x 8 x ½ plain		27—4 x 8 x ½ plain	17	
			1½ sheets 4 x 8 x ⅛″ black hardboard.		Furnace room front and back panel.
E. Taping			5-gal. plastic cement		Allowance was made in the estimate but no quantity of material was ascertained.
			25# joint taping cement		
			250# joint taping system		
			1 knife		
F. Trim			266 lin. ft. 2½ ceiling casing trim.		Overlooked in estimate.
			386 lin. ft. 2″ base casing trim		
			1—16′ 0″ ½″ quarter rd		
			2—1⅜ x 10 corner bead trim		
			1—1 x 6 x 12′		
H. Plastering 1 and 2					
Component 14.—DOORS	1—Comb-3′ 0″ x 6′ 8″		1—Comb-3′ 0″ x 6′ 8″		
	2—Comb-3′ 0″ x 6′ 8″		2—Comb-3′ 0″ x 6′ 8″		
	1—Ext-3′ 0″ x 6′ 8″ x 1¾		1—Ext-3′ 0″ x 6′ 8″ x 1¾		
	2—Ext-2′ 8″ x 6′ 8″ x 1¾		2—Ext-2′ 8″ x 6′ 8″ x 1¾		
	3—Int-2′ 6″ x 6′ 8″ x 1⅜		3—Int-2′ 6″ x 6′ 8″ x 1⅜		
	1—Int-2′ 4″ x 6′ 8″ x 1⅜		1—Int-2′ 4″ x 6′ 8″ x 1⅜		
A. Jamb	4—1 x 4 x 14′		4—1 x 4 x 14′		
	1—1 x 4 x 12′		1—1 x 4 x 16′		
	3—5/4 x 4 x 14′		72 lin. ft. 5/4 x 6″		Material not available in 5/4″ size.
	1—5/4 x 4 x 12′		1—⅜ base trim		Used for door stops.
			2—1 x 6 x 16′		Used for jamb in kitchen.
			1—1 x 6 x 12′		
B. Trim	3—5/4 x 1⅝ x 14′		1—5/4 x 16 x 8′		
	1—5/4 x 1⅝ x 12′		5—5/4 x 6 x 8′		
			3—1 x 6 x 12′		

TABLE 2.—*Waste study—House A*—Continued

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 14.—DOORS—Con.					
C. Hanging hinges	4—½ pr. 4" x 4 butts		4—½ pr. 4" butts		
	6 pr. 3½ x 3½ butts		6 pr. 3½" butts		
			3 pr. cadium surface spring hinges.		For combination doors.
D. Hardware	3 exterior locks		3 exterior locks		
	1 privacy lock		1 privacy		
	3 bedroom locks		3 bedroom		
	A405		3 door catches		For combination doors.
			3 safety chains		For combination doors.
E. Door stops	7 door stops				
Component 15.—SEPTIC TANKS:	1 septic tank		1 septic tank		
	1 distribution box		1 distribution box		Subcontract.
Component 16.—CABINETS:					
A.1 Kitchen base			2—1 x 6 x 12'		Since cabinets were to be built in place, no material estimate was made. However, a blanket sum was included in cost estimate.
			4—4 x 8 x ¾ plywood		
			2—2 x 4 x 16		
			1# wood putty		
			4—1 x 6 x 12		
			1—1 x 8 x 12'		
			4 x 8 x ⅛" black hardboard		
			16 lin. ft. red lines countertop covering.		
			2 qts. mastic		
			3 lin. ft. molding		
			5 door catches		
			15 cap hinges		
			11 catches		
			13 door knobs		
			24 lin. ft. edging		
			16 lin. ft. cap		
			18 lin. ft. cove		
			1 qt. mastic		
A.2 Kitchen wall			1—4 x 8 x ⅛" brown hardboard		
			2—1 x 10 x 14'		
			2—1 x 12 x 16'		
			2—1 x 12 x 14'		
			20 lin. ft. pilaster strips		
			28 shelf cleats		
B. Utility					
C. Bath			3—1 x 4 x 10		
			1—1 x 12 x 16		
			4 lin. ft. pilaster strips		
			4 shelf cleats		
Component 17.—CLOSET WALL UNITS:					
A. Framework			2—4 x 8 x ¾" plywood S2S		
			3—1 x 6 x 12'		
			4—2 x 8 x ⅛ hardboard temp. 2 sides.		
			8—2 x 4 x 12'		
			2—2 x 4 x 18'		
			1—2 x 4 x 16'		
			4—1 x 8 x 16'		
			1—1 x 12 x 16'		
			21—1 x 8 x 8'		
			4—1 x 6 x 12'		
			1—1 x 4 x 16'		
			1—1 x 4 x 12'		
			4—1 x 8 x 12'		
			3—4 x 8 x ⅛" temp. hardboard		
			3—4 x 8 x ⅜ plasterboard		
			2 gal. linoleum paste		
			14 ft. 1¼ closet pole		
			8' 1⅜" closet pole		
			150 lin. ft. ¾" quarter round		

TABLE 2.—*Waste study—House A*—Continued

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 17.—CLOSET WALL UNITS—Continued					
B.1 Doors			2—4 x 8 x ¾ S1S		Folding doors are to be installed.
C. Free standing units			5# glue		No estimate made.
			12—4 x 8 x ⅛ black hardboard		Blanket sum included in cost estimate.
			5—2 x 4 x 12′		
			2—1 x 14 x 14′		
			9—1 x 12 x 16′		
			9—1 x 8 x 14′		
			11—1 x 8 x 12′		
			11—1 x 6 x 12′		
			1—1 x 4 x 12′		
Component 18.—PAINTING					Subcontract.
Component 19.—FLUE (Prefabricated).	1 prefabricated flue		1 prefabricated flue		
Component 20.—PLUMBING					Do.
Component 21.—HEATING					Do.
Component 22.—GARAGES:					
A. Floor	2 cu. yd. concrete (footing)		2.77 cu. yd. concrete		Additional amount required due to irregularity of trench.
	224—8 x 8 x 16 (concrete blocks)		227—8 x 8 x 16		Excess ordered to take care of breakage.
	51—4 x 8 x 16		52—4 x 8 x 16		
	6 cu. yd. concrete (slab)	20	3.59 cu. yd. concrete		Material estimate was too liberal.
			1 sack cement		Used to finish slab.
			15 yds. gravel		Used as fill.
B. Walls	10—2 x 4 x 12′		15—2 x 4 x 12′		Didn't follow cutting and order schedule.
	26—2 x 4 x 14′		25—2 x 4 x 14′		
	7—2 x 4 x 16′		14—2 x 4 x 16′		Door bucks had to be recut. Additional blocking was necessary under windows.
	12′ 6″ stran-steel		12′ 6″ stran-steel		
	14—4 x 8 x ⅛″ siding		15—4 x 8 x ⅛″		
	14—4 x 8 x 25/32 sheathing		15—4 x 8 x 25/32		Additional material bought in case any breakage occurred.
			4—1 x 6 x 8′		Overlooked in estimate.
			4—1 x 8 x 8′		
	25 battens		4—1 x 6 x 16′ battens		No waste.
	1—1 x 6 x 8′		1—1 x 6 x 8′ frieze		
C. Roof	13—2 x 8 x 16′		15—2 x 8 x 16′		
	13—2 x 8 x 12′		13—2 x 8 x 12′		
	2—2 x 8 x 8′				
	1—2 x 8 x 6′				The roof detail was changed.
	1—4 x 4 x 10′		1—4 x 4 x 10′		
			1—2 x 8 x 14′		
			1—2 x 4 x 16′		Blocking between joists.
	Sheathing				
	110—1 x 6 x 14′ T/G		188—1 x 6 x 10 T/G		Enlarged breezeway and roof required more sheathing.
	650 sq. ft. 15# felt		1,000 sq. ft. 15# felt		Enlarged roof and overlap required more felt.
	6½ sqs. selv. roofing		5½ sqs. selv. roofing		
	84 lin. ft. starter strip		90 lin. ft. starter strip		Material available in 10-ft. lengths.
	3—1 x 10 x 12′ fascia		1—1 x 10 x 8′		Mistake in estimate and detail change.
			4—1 x 10 x 14′		
			2—1 x 10 x 12′		
	68—1 x 6 x 14′ S/L Soffit		20—1 x 8 x 14′ S/L		Material available only as 1 x 8.
			24—1 x 8 x 12′ S/L		Do.
			80 lin. ft. ¾″ quarter round		Required to seal junction of soffit and wall.
D. Doors and windows	1 panel door 3′ 0″ x 6′ 8″		1 panel door 3′ 0″ x 6′ 8″		
	1½ pr. butts		1½ pr. 3½″ butts		
	1 lock set		1 lock set		
Component 23.—WALKS AND DRIVES:					
A. Walks			.14 cu. yd. concrete		
			3—2 x 4 x 12′		Screeds.
B. Drives	15 ft. 8″ reinforced concrete tile.		15 ft. 8″ reinforced concrete tile.		
	19 yds. pit run gravel		50 yds. pit run gravel		Extra gravel needed because finish grade is high.
	7 tons crushed rock				

TABLE 2.—*Waste study—House A*—Continued

Component	Estimate	Allowance (percent)	Actual	Required (percent)	Remarks
Component 23.—WALKS AND DRIVES—Continued					
C. Stoops			2—2 x 8 x 12′		Forms.
			2—2 x 8 x 14′		
			1.92 cu. yd. concrete		
E. Fence			5—4 x 8 x ⅛″ temp. hardboard.		No estimate was made, instead a blanket sum was included in the cost estimate.
			1—4 x 4 x 14′		
			2—2 x 4 x 16′		
			2—2 x 6 x 14′		
			7—2 x 4 x 12′		
			9—2 x 4 x 16′		
			1—2 x 6 x 16′		
			24—½ x 6″ bolts		
Component 24.—ROUGH GRADING:					
A. Rough			32 loads earth		
Component 30. — MISCELLANEOUS					A blanket sum was included for this item.

PART V

Assembly Procedures, and Material and Labor-Time Records During Construction—House B

The procedures followed by the contractor during the building of the second demonstration house (House B) are reported in this section. Materials used and labor time are recorded for each individual component, following the "Outline for Components of Labor and Material Study," (p. 5). Details of the particular component are shown, where feasible, for ready reference and comparison.

These details, and materials and labor-time records provide the necessary data for detailed comparisons of a builder's current practices and costs, and form the basis for judgment as to the successful demonstration of benefits in the new techniques used.

Component 1.—Earth Preparation

COMPONENT 1.—EARTH PREPARATION (HOUSE B)

A.—SCRAPE 1.—MACHINE

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Total labor					$22.00
Total material					None
Total labor and material					22.00

Component 2.—Layout

Plot Plans.—The house plan is designed so that principal living areas will face south. House B is located on a lot on the south side of the street. The south elevation was placed to the rear of the lot, both for privacy of the outdoor living area and for maximum utilization of the sun. (Since this lot does not face due south, this house is not parallel with the street.) This placement has added merit in that access drive, utilities and service area are close to the street. The service yard is protected by a screening fence. It is assumed that an outdoor living area or terrace will be developed.

COMPONENT 2.—LAYOUT (HOUSE B)

A.—MEASURING, STAKING, ETC.

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, skilled	7-7	1	½	$2.50	$1.25
Carpenter, apprentice	7-7	1	½	1.75	.88
Carpenter, skilled	7-9	1	2	2.50	5.00
Carpenter, apprentice	7-9	2	6½	1.75	11.38
Carpenter, skilled	7-12	1	1	2.50	2.50
Carpenter, apprentice	7-12	1	1	1.75	1.75
Total labor					22.76
Total material					None
Total labor and material					22.76

B.—BATTER BOARDS

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Carpenter, skilled	7-12	1	5¾	$2.50	$14.38
Carpenter, apprentice	7-12	1	5¾	1.75	9.03
Total labor					23.41

Material	*Date*	*Amount in units*	*Amount used*	*Price per unit*	*Cost*
1 x 6 x 10′ T. & G. YP	7-14	9 pcs.	45 bd. ft.	$0.135	$6.08
2 x 4 x 12′ No. 1 and 2 fir	7-14	1 pc.	8 bd. ft.	.145	1.16
Total material					7.24
Total labor and material					30.65

Component 3.—Excavation

COMPONENT 3.—EXCAVATION (HOUSE B)

A.—TRENCHING FOR FOOTINGS 2.—HAND LABOR

Labor	*Date*	*Number of workers*	*Total hours worked*	*Hourly rate*	*Cost*
Laborer, unskilled	7-9	2	5	$1.85	$9.25
Do	7-10	4	27	1.85	49.95
Do	7-11	2	2	1.85	3.70
Total labor					62.90
Total material					None
Total labor and material					62.90

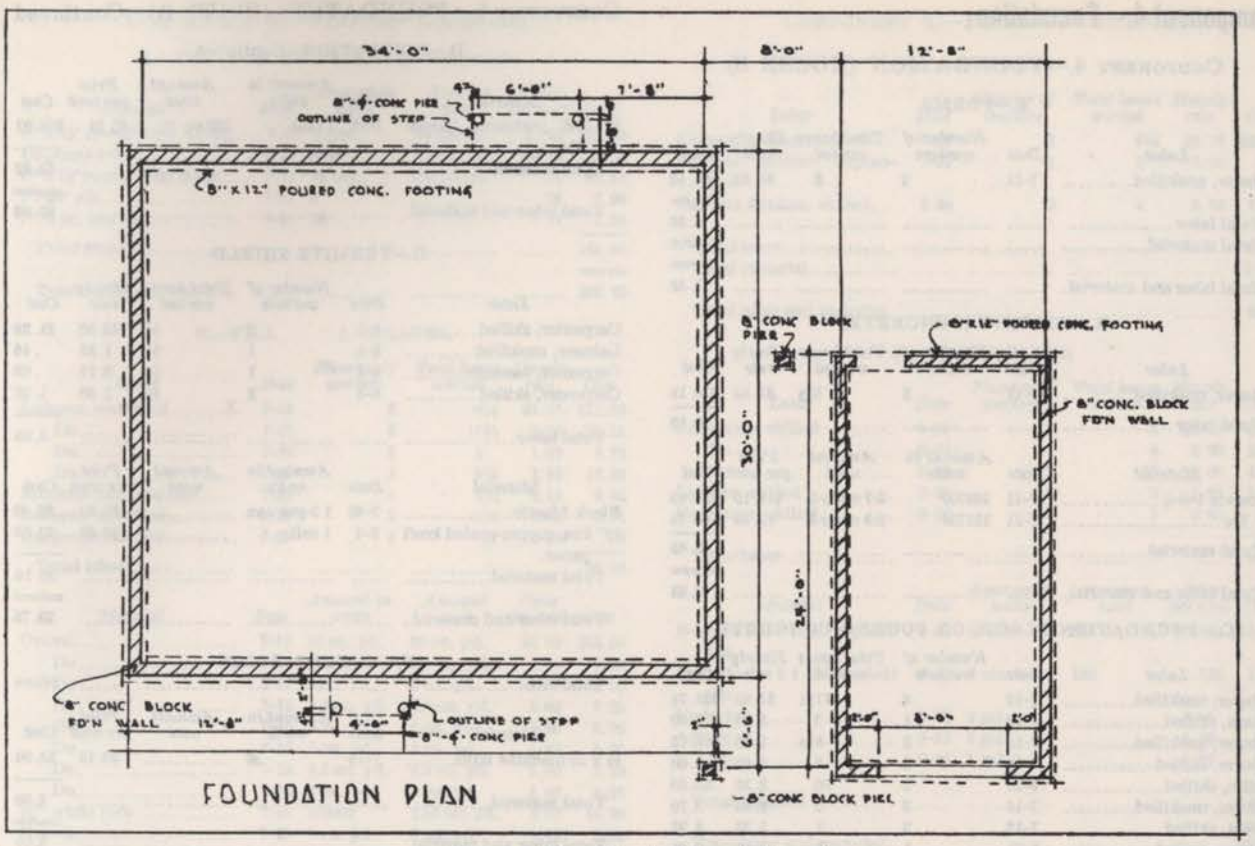


FIGURE 60.—*House B foundation plan.*

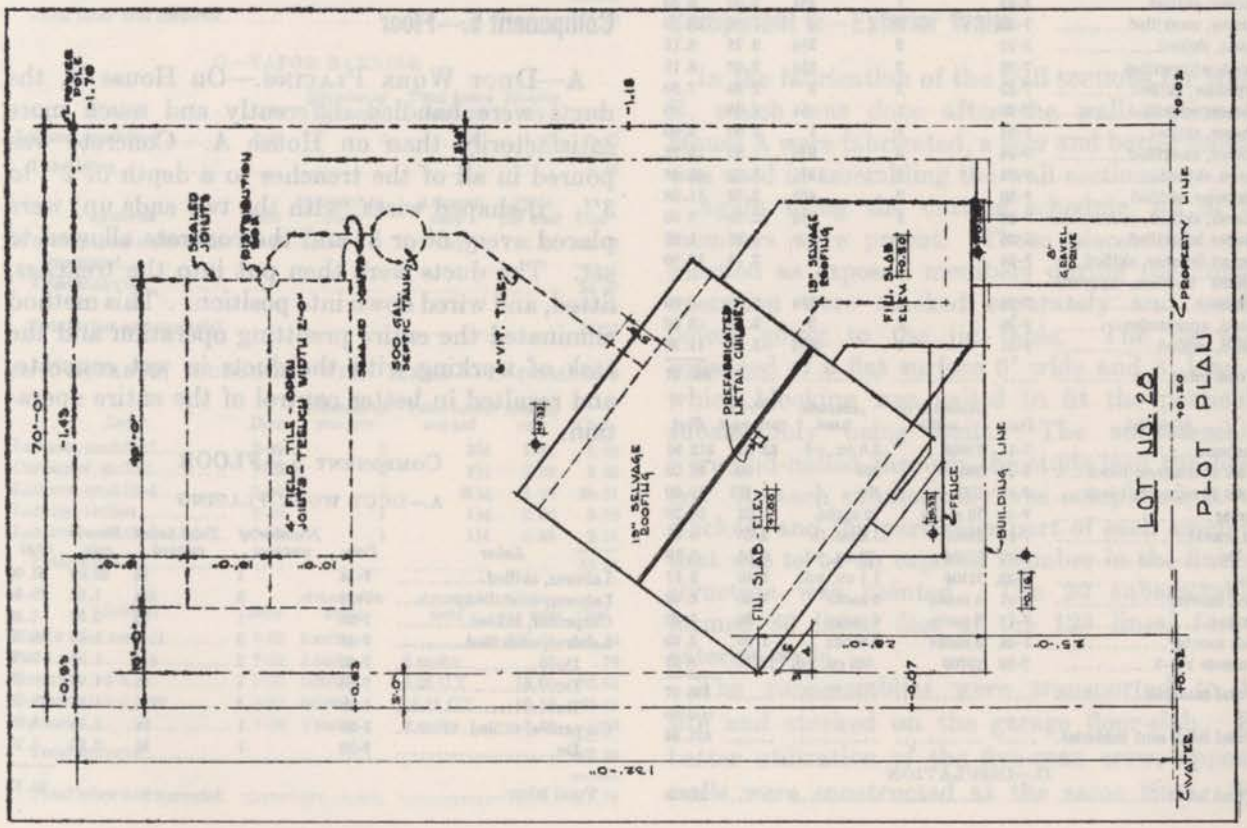


FIGURE 59.—*House B plot plan.*

Component 4.—Foundation

Component 4.—FOUNDATION (HOUSE B)

A.—FORMS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-11	2	3	$1.85	$5.55
Total labor					5.55
Total material					None
Total labor and material					5.55

B.—FOOTING (CONCRETE)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-11	3	5½	$1.85	$10.18
Total labor					10.18

Material	Date	Amount in units	Amount used	Price per unit	Cost
Concrete 1-3-5	7-11	10870#	2.7 cu. yd.	$12.10	$32.92
Do	7-11	10170#	2.5 cu. yd.	12.10	30.73
Total material					63.65
Total labor and material					73.83

C.—FOUNDATION BLOCK, OR POURED CONCRETE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-12	4	11¾	$1.85	$21.74
Mason, skilled	7-12	1	2	3.25	6.50
Laborer, unskilled	7-14	3	8½	1.85	15.73
Laborer, skilled	7-14	3	3	2.00	6.00
Mason, skilled	7-14	3	10	3.25	32.50
Laborer, unskilled	7-15	2	2	1.85	3.70
Mason, skilled	7-15	2	1	3.25	3.25
Laborer, skilled	7-21	1	3	2.00	6.00
Laborer, unskilled	7-21	3	7	1.85	12.95
Laborer, skilled	7-22	1	4¾	2.00	9.50
Laborer, unskilled	7-22	3	14	1.85	25.90
Mason, skilled	7-23	2	2½	3.25	8.13
Mason, apprentice	7-23	2	3¼	2.50	8.13
Carpenter, skilled	7-23	2	3	2.50	7.50
Laborer, unskilled	7-23	1	¼	1.85	.46
Laborer, skilled	7-24	1	1	2.00	2.00
Laborer, unskilled	7-24	3	8½	1.85	15.73
Mason, skilled	7-24	3	12¾	3.25	41.44
Carpenter, skilled	7-28	2	4¾	2.50	11.88
Laborer, skilled	7-28	1	3¼	2.00	6.50
Laborer, unskilled	7-28	1	1	1.85	1.85
Cement finisher, skilled	7-28	2	6	2.75	16.50
Cement finisher, apprentice	7-28	1	1½	2.00	3.00
Mason, apprentice	7-28	1	2	2.50	5.00
Mason, skilled	7-31	2	3½	3.25	11.38
Total labor					283.27

Material	Date	Amount in units	Amount used	Price per unit	Cost
Fine sand	7-11	7260#	3.6 cu. yd.	$3.40	$12.34
8 x 8 x 16 concrete block	7-14	298	298	.205	61.09
4 x 8 x 16 concrete block	7-14	100	100	.175	17.50
Mortar	7-14	10 sacks	10 sacks	1.02	10.20
Pea gravel	7-19	3240#	1.6 cu. ft.	3.65	5.91
Do	7-22	1750#	.88 cu. yd.	3.65	3.19
Sand	7-22	2110#	1.1 cu. yd.	3.40	3.57
Brick mortar	7-11	5 sacks	5 sacks	1.20	6.00
Cement	7-11	6 sacks	6 sacks	1.30	7.80
Brick mortar	7-24	3 sacks	3 sacks	1.20	3.60
Concrete 1-3-5	7-28	2270#	.568 cu. yd.	12.10	6.87
Total material					138.07
Total labor and material					421.34

D.—INSULATION

Total labor					None

Component 4.—FOUNDATION (HOUSE B)—Continued

D.—INSULATION—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1" AE perimeter insulation.	7-18	7 ctns.	252 sq. ft.	$0.21	$52.92
Total material					52.92
Total labor and material					52.92

E.—TERMITE SHIELD

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-1	2	½	$2.50	$1.25
Laborer, unskilled	8-1	1	¼	1.85	.46
Carpenter, foreman	8-4	1	¼	2.75	.69
Carpenter, skilled	8-4	2	½	2.50	1.25
Total labor					3.65

Material	Date	Amount in units	Amount used	Price per unit	Cost
Black Mastic	7-30	1 5-gal. can		$3.60	$3.60
10" 3 oz. copper-coated kraft paper.	8-1	1 roll		22.50	22.50
Total material					26.10
Total labor and material					29.75

F.—ANCHOR BOLTS

Total labor					None

Material	Date	Amount in units	Amount used	Price per unit	Cost
½ x 10 machine bolts	7-15	20		$0.15	$3.00
Total material					3.00
Total labor and material					3.00

Component 5.—Floor

A—Duct Work Placing.—On House B, the ducts were handled differently and much more satisfactorily than on House A. Concrete was poured in all of the trenches to a depth of 2" to 3". U-shaped wires (with the two ends up) were placed every 6' or 8' and the concrete allowed to set. The ducts were then put into the trenches, fitted, and wired down into position. This method eliminated the entire prefitting operation and the task of working with the ducts in wet concrete, and resulted in better control of the entire operation.

Component 5.—FLOOR

A.—DUCT WORK PLACING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, skilled	7-24	1	½	$2.00	$1.00
Laborer, unskilled	7-24	3	5¾	1.85	10.64
Carpenter, skilled	7-25	1	½	2.50	1.25
Laborer, unskilled	7-25	3	11	1.85	20.35
Do	7-28	2	4¼	1.85	7.86
Do	7-28	1	½	1.85	.93
Do	7-29	5	22¼	1.85	41.16
Carpenter, skilled	7-29	1	¾	2.50	1.88
Do	7-30	1	½	2.50	1.25
Total labor					86.32

COMPONENT 5.—FLOOR—Continued

A.—DUCT WORK PLACING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
7" x 18' round fiber ducts	7-17	3 pcs.	54 lin. ft.	$0.32	$17.28
Concrete 1-3-5	7-25	8430#	2.1 cu. yd.	12.10	25.50
7" x 18' round fiber ducts	7-31	12 pcs.	270 lin. ft.	.32	86.40
7"-90° ells	7-31	8		.90	7.20
7"-2 pc. angles	7-31	10		.75	7.50
Total material					143.88
Total labor and material					230.20

B.—FILL 2.—GRAVEL

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-14	5	6¼	$1.85	$11.56
Do	7-15	3	11½	1.85	21.28
Do	7-24	3	2	1.85	3.70
Do	7-25	3	9½	1.85	17.58
Machine and operator	7-25	1	1½	6.00	9.00
Laborer, unskilled	7-28	2	1¼	1.85	2.31
Carpenter, skilled	7-29	1	¼	2.50	.63
Total labor					66.06

Material	Date	Amount in units	Amount used	Price per unit	Cost
Gravel	7-15	20 cu. yd.	20 cu. yd.	$1.60	$32.00
Do	7-15	4.5 cu. yd.	4.5 cu. yd.	1.60	7.20
Do	7-15	5 cu. yd.	5 cu. yd.	1.60	8.00
Do	7-15	4.5 cu. yd.	4.5 cu. yd.	1.60	7.20
Do	7-15	5 cu. yd.	5 cu. yd.	1.60	8.00
Do	7-15	5 cu. yd.	5 cu. yd.	1.60	8.00
Do	7-15	4.5 cu. yd.	4.5 cu. yd.	1.60	7.20
Do	7-15	5 cu. yd.	5 cu. yd.	1.60	8.00
¾" white rock	7-25	13300#	6.65 cu. yd.	2.90	19.29
Gravel	7-25	3 cu. yd.	3 cu. yd.	1.60	4.80
Total material					109.69
Total labor and material					175.75

C.—VAPOR BARRIER

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-25	3	3	1.85	5.55
Total labor					5.55

Material	Date	Amount in units	Amount used	Price per unit	Cost
8' kraft paper, asphalt impregnated.	7-25	1 roll	1,200 sq. ft.	$0.02	$24.00
Total material					24.00
Total labor and material					29.55

D.—CONCRETE, INCLUDING WIRE MESH 1.—DUMPING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-29	3	2¾	1.85	5.09
Carpenter, skilled	7-30	2	2¼	2.50	5.63
Laborer, unskilled	7-30	5	21¼	1.85	39.31
Laborer, skilled	7-30	1	1½	2.00	3.00
Laborer, unskilled	7-30	1	1¼	1.85	2.31
Total labor					55.34

Material	Date	Amount in units	Amount used	Price per unit	Cost
No. 10 wire mesh	7-25	2 rolls		$20.63	$41.25
Sand	7-30	2 sacks	2 sacks	.35	.70
Concrete 1-2-4	7-30	16300#	4.08 CY	13.00	53.04
Concrete 1-3-5	7-30	54050#	13.51 CY	12.10	163.47
Cement	7-30	3 sacks	3 sacks	1.30	3.90
Total material					262.36
Total labor and material					317.70

COMPONENT 5.—FLOOR—Continued

2.—FINISHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Cement finisher, skilled	7-30	2	8½	$2.75	$23.38
Cement finisher, apprentice.	7-30	1	2	2.00	4.00
Cement finisher, skilled	7-30	2	4	2.75	11.00
Total labor					38.38
Total material					None
Total labor and material					38.38

G.—FINISH FLOOR

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-23	2	3	$2.60	$7.80
Do	9-24	1	8	2.60	20.80
Do	9-25	2	16	2.60	41.60
Laborer, skilled	9-25	1	8	1.85	14.80
Carpenter, skilled	9-26	1	1	2.60	2.60
Total labor					87.60

Material	Date	Amount in units	Amount used	Price per unit	Cost
B-grade 9 x 9 x ⅛" asphalt tile.	9-23	19 ctns.	855 sq. ft.	$0.125	$106.87
D-grade 9 x 9 x ⅛" asphalt tile.	9-23	3 ctns.	135	.125	16.88
Underlay	9-23	5 gal.		1.95	9.75
Adhesive	9-23	5 gal.		1.20	6.00
Do	9-25	1 gal.		1.20	1.20
Total material					140.70
Total labor and material					228.30

Component 6.—Exterior Walls

In the fabrication of the wall sections for House B, which was done after the wall sections of House A were fabricated, a new and better method was used in assembling the wall sections.

Again using the cutting schedule, all of the members were precut. Those pieces that were selected as exposed members during the cutting operation were stacked separately and sanded before going to the jig table. The jig table consisted of a flat surface 6' wide and 8' long on which blocking was nailed to fit the particular subassembly being built. The subassemblies were end-nailed through the studs into the headers. As each subassembly was completed, it was stacked, and the particular part of each assembly that was to be an exposed member in the finished structure was painted. The 20 subassemblies formed 80 lineal feet of the 128 lineal feet of exterior walls.

The subassemblies were transported to the site and stacked on the garage floor-slab. For better utilization of the five-man crew, opposite walls were constructed at the same time. The

plates were put down and marked for stud spacing, and slots were cut for the anchor bolts. Subassemblies were then placed between the plates in their respective positions and end-nailed. In the 44 lineal feet of wall that had no subassemblies, studs were nailed in the usual fashion. Trim, sheathing, siding, and battens were applied, as described under House A, and tipped into place.

COMPONENT 6.—EXTERIOR WALLS (HOUSE B)

A.—WALL FRAMING (INCLUDES TOP AND BOTTOM PLATE, STUDS, HEADERS, BLOCKING, LET-IN-BRACING, TEMPORARY BRACING)

1.—BUILDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7-21	1	3¼	$2.75	$8.94
Carpenter, skilled	7-21	5	4¼	2.50	10.63
Laborer, unskilled	7-30	2	1	1.85	1.85
Carpenter, skilled	7-31	3	2½	2.50	6.25
Laborer, unskilled	7-31	1	1	1.85	1.85
Carpenter, skilled	8-1	2	3	2.50	7.50
Laborer, unskilled	8-1	1	1½	1.85	2.78
Carpenter, foreman	8-4	1	1½	2.75	4.12
Carpenter, skilled	8-4	3	5¼	2.50	13.13
Laborer, unskilled	8-4	1	1	1.85	1.85
Carpenter, skilled	8-12	2	1	2.50	2.50
Total labor					61.40

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 7′ 8″ No. 1 and 2 fir	7-18	80 pcs.	427 bd. ft.	$0.145	$61.92
2 x 4 x 18′ 8″ No. 1 and 2 fir	7-18	29 pcs.	348 bd. ft.	.14½	50.46
2 x 4 x 16′ 8″ No. 1 and 2 fir	7-18	7 pcs.	75 bd. ft.	.14½	10.88
1 x 4 x 12′ Std. S4S	7-18	1 pc.	4 bd. ft.	.13½	.54
16d common nails	7-31	50# ctn.			5.50
2 x 4 x 7′ 8″ No. 1 and 2 fir	7-31	10 pcs.	53 bd. ft.	.14½	7.69
2 x 4 x 18′ No. 1 and 2 fir	7-31	9 pcs.	112 bd. ft.	.14½	15.66
2 x 4 x 16′ No. 1 and 2 fir	7-31	2 pcs.	21 bd. ft.	.14½	3.05
2 x 4 x 12′ No. 1 and 2 fir	7-31	1 pc.	8 bd. ft.	.14½	1.16
Glue	7-31	5#			3.75
2 x 4 x 16′ No. 1 and 2 fir	8-4	4 pcs.	43 bd. ft.	.145	6.24
Aluminum flashing	8-21	2 pcs.	8 lin. ft.	1.50	3.00
Total material					169.85
Total labor and material					231.25

A.—WALL FRAMING 2.—ERECTION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-1	4	5¾	$2.50	$14.38
Laborer, unskilled	8-1	2	2	1.85	3.70
Carpenter, foreman	8-4	1	2¼	2.75	6.19
Carpenter, skilled	8-4	3	7¼	2.50	18.13
Laborer, unskilled	8-4	1	1¾	1.85	3.24
Carpenter, foreman	8-13	1	1¾	2.75	4.81
Carpenter, skilled	8-13	3	8¼	2.50	20.63
Total labor					71.08
Total material					None
Total labor and material					71.08

B.—SHEATHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-31	3	2	$2.50	$5.00
Laborer, unskilled	7-31	1	¾	1.85	1.39
Carpenter, skilled	8-1	3	¾	2.50	1.88
Laborer, unskilled	8-1	1	¼	1.85	.46
Carpenter, foreman	8-4	1	¾	2.75	2.06

COMPONENT 6.—EXTERIOR WALLS (HOUSE B)—Con.

B.—SHEATHING—Continued

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-4	3	1¾	$2.50	$4.38
Laborer, unskilled	8-4	1	½	1.85	.93
Carpenter, skilled	8-5	2	½	2.50	1.25
Total labor					17.35

Material	Date	Amount in units	Amount used	Price per unit	Cost
4′ x 8′ x 25/32″ insulation sheathing.	7-31	21 pcs.	672 sq. ft.	$0.12	$80.64
Total material					80.64
Total labor and material					97.99

D.—SIDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, unskilled	7-28	2	4¼	$2.50	$10.63
Laborer, unskilled	7-28	1	1¾	1.85	3.24
Carpenter, skilled	7-31	2	2¾	2.50	6.88
Laborer, unskilled	7-31	1	1½	1.85	2.78
Carpenter, skilled	8-1	2	3¼	2.50	8.13
Laborer, unskilled	8-1	1	1¼	1.85	2.31
Carpenter, foreman	8-4	1	1¼	2.75	3.44
Carpenter, skilled	8-4	3	3¾	2.50	9.38
Laborer, unskilled	8-4	1	2	1.85	3.70
Carpenter, foreman	8-5	1	2¼	2.75	6.19
Carpenter, skilled	8-5	4	7½	2.50	18.75
Do	8-11	1	¼	2.50	.63
Do	8-13	2	2½	2.50	6.25
Carpenter, foreman	8-13	1	¾	2.75	2.06
Do	8-14	1	¼	2.75	.69
Carpenter, skilled	7-31	2	1½	2.50	3.75
Do	8-18	1	1¼	2.50	3.13
Do	8-28	1	½	2.60	1.30
Total labor					93.24

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 4 x 16′ No. 1 W. P	7-28	16 pcs.	85 bd. ft.	$0.24	$20.40
4 x 8 x 1/8″ temp. hardboard	7-31	3 pcs.	96 sq. ft.	.11	10.56
4 x 8 x 1/8″ asbestos cement board.	7-31	17 pcs.	544 sq. ft.	.11½	62.56
1 x 6 x 16′ No. 1 W. P	7-31	1 pc.	8 bd. ft.	.24	1.92
Calking	7-31	5 gal.		2.95	14.75
1 x 6 x 8′ CVG fir	8-7	4 pcs.	16 bd. ft.	.34	5.44
1 x 8 x 8′ CVG fir	8-7	3 pcs.	16 bd. ft.	.34	5.44
1 x 6 x 12′ No. 1 W. P	8-13	4 pcs.	24 bd. ft.	.24	5.76
Total material					126.83
Total labor and material					220.07

E.—GABLE END TOTAL

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-5	1	2½	$2.75	$6.19
Carpenter, skilled	8-5	5	14	2.50	12.50
Laborer, unskilled	8-5	1	5	1.85	9.25
Carpenter, foreman	8-11	1	½	2.75	1.38
Carpenter, skilled	8-11	1	½	2.50	1.25
Do	8-13	2	½	2.50	1.25
Do	8-14	1	¾	2.50	1.88
Do	8-15	1	¾	2.50	1.88
Total labor					35.58

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 6 x 20′ No. 1 and 2 fir	8-4	4 pcs.	80 bd. ft.	$0.15	$12.00
2 x 4 x 16′ No. 1 and 2 fir	8-4	13 pcs.	139 bd. ft.	.145	20.16
2 x 8 x 12′ No. 1 and 2 fir	8-4	4 pcs.	64 bd. ft.	.145	9.28

COMPONENT 6.—EXTERIOR WALLS (HOUSE B)—Con.

E.—GABLE END TOTAL—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ Std. D. & M	8–4	2 pcs.	11 bd. ft.	$0.135	$1.49
1 x 6 x 14′ Std. D. & M	8–4	1 pc.	7 bd ft.	.135	.95
¾ x 8 A and C RW Bev. Sdg.	8–4	256 pcs.	264 bd. ft.	.28	73.92
2 x 8 x 16′ No. 1 and 2 fir	8–4	1	21 bd. ft.	.145	3.05
2 x 6 x 10′ No. 1 and 2 fir	8–4	1	10 bd. ft.	.145	1.45
¾ x 8 x 12′ RW Bev. Sdg	8–5	2 pcs.	16 bd. ft.	.28	4.48
2 x 4 x 16′	8–5	3 pcs.	32 bd. ft.	.145	4.64
Total material					131.42
Total labor and material					$167.00

F.—LOUVERS 1.—BUILDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	7–14	1	5	$2.75	$13.75
Laborer, unskilled	7–14	1	3½	1.85	6.48
Carpenter, skilled	7–18	2	8½	2.50	21.25
Do	7–21	2	13	2.50	32.50
Do	8–19	1	1¼	2.50	3.13
Carpenter, foreman	8–29	1	2¾	2.85	7.84
Carpenter, skilled	8–29	2	3¾	2.60	9.75
Carpenter, apprentice	8–29	1	1	1.50	1.50
Carpenter, skilled	9–3	2	2	2.60	5.20
Do	9–4	2	13¾	2.60	35.75
Do	9–5	2	8¼	2.60	21.45
Total labor					158.60

Material	Date	Amount in units	Amount used	Price per unit	Cost
½ x 10″ x 10′ CWP	7–16	4 pcs.	33 bd. ft.	$0.42	$13.86
Mill labor	7–16				1.15
1 x 6 x 12′ No. 1 WP	7–18	20 pcs.	120 bd. ft.	.24	28.80
1 x 6 x 8′ CWP	7–21	2 pcs.	8 bd. ft.	.42	3.36
½ x 8 x 16′ CWP	8–19	3 pcs.	32 bd. ft.	.30	9.60
1 x 10 x 12′ DWP	8–29	6 pcs.	60 bd. ft.	.34	20.40
1 x 12 x 12′ CWP	8–29	3 pcs.	36 bd. ft.	.45	16.20
1 x 10 x 12′ DWP	9–2	2 pcs.	20 bd. ft.	.35	7.00
1 x 10 x 16′ DWP	9–2	3 pcs.	40 bd. ft.	.35	14.00
Catches	9–4	32		.10	3.20
1¾-10 screws	9–5	2 doz.		.21	.42
½ box 508C staples	8–19	½ box		3.00	1.00
Outside white primer	9–10	2 qts.		1.85	3.33
Total material					122.32
Total labor and material					280.92

F.—LOUVERS 2.—PLACING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8–5	2	8	$2.50	$20.00
Do	9–3	2	½	2.60	1.30
Do	9–4	1	¾	2.60	1.95
Carpenter, apprentice	9–11	1	¾	1.50	1.13
Total labor					24.38
Total material					None
Total labor and material					24.38

Component 7.—Roof

COMPONENT 7.—ROOF (HOUSE B)

A.—TRUSS 1.—BUILDING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7–24	1	1¾	$2.50	$4.38
Laborer, unskilled	7–24	1	1¼	1.85	2.31
Carpenter, foreman	7–24	1	¾	2.75	2.06
Supervisor	7–24	2	1¼		
Carpenter, skilled	7–25	2	11	2.50	27.50
Carpenter, foreman	7–25	1	3½	2.75	9.63
Laborer, unskilled	7–25	1	5¾	1.85	10.64
Carpenter, skilled	7–28	2	4¾	2.50	11.88
Do	8–6	2	1	2.50	2.50
Carpenter, foreman	8–28	1	1	2.85	2.85
Carpenter, skilled	8–28	1	1	2.60	2.60
Do	9–3	2	2	2.60	5.20
Total labor					81.55

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12′ No. 1 and 2 fir	7–24	32 pcs.	256 bd. ft.	$0.145	$37.12
2 x 4 x 16′ No. 1 and 2 fir	7–24	32 pcs.	341 bd. ft.	.145	49.45
2½″ ring connectors	7–24	100		.15	15.00
2 x 6 x 12′ No. 1 and 2 fir	7–24	32 pcs.	384 bd. ft.	.145	55.68
2 x 6 x 10′ No. 1 and 2 fir	7–24	32 pcs.	320 bd. ft.	.145	46.40
¾″ x 4″ bolts	7–25	50 pcs.	50	.17	8.53
Washers	7–25	7 lb.			1.40
¾″ washers	7–25				2.00
½″ washers	7–25				.80
½″ x 4″ machine bolts	7–25	33 pcs.	33	.03	1.08
½″ x 7″ machine bolts	7–25	17 pcs.	17	.15	2.55
¾″ x 4½″ machine bolts	7–25	50	50	.18	9.00
¾″ wood bit	7–25	1			1.28
1 x 6 x 10′ T. & G. sheathing	9–3	2 pcs.	10 bd. ft.	.135	1.35
Split-ring cutter rented June 27–July 7.		1			14.00
Total material					245.64
Total labor and material					327.19

2.—PLACING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8–4	1	¾	$2.75	$2.06
Carpenter, skilled	8–4	3	2¾	2.50	6.88
Laborer, unskilled	8–4	3	4¾	1.85	8.79
Carpenter, foreman	8–5	1	¾	2.75	2.06
Carpenter, skilled	8–5	3	3	2.50	7.50
Total labor					27.29
Total material					none
Total labor and material					27.29

C.—SHEATHING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8–5	5	6¼	$2.50	$15.63
Laborer, unskilled	8–5	1	1¼	1.85	2.31
Carpenter, foreman	8–6	1	¼	2.75	.69
Carpenter, skilled	8–6	5	13¾	2.50	34.38
Laborer, unskilled	8–6	1	3	1.85	5.55
Total labor					58.56

COMPONENT 7.—ROOF (HOUSE B)—Continued

C.—SHEATING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ Std. D. & M.	8–4	166	996 bd. ft.	$0.135	$134.36
1 x 6 x 14′ Std. D. & M.	8–4	83	581 bd. ft.	.135	78.44
1 x 6 x 12′ Std. D. & M.	8–6	14 pcs.	84 bd. ft.	.135	11.34
Total material					224.14
Total labor and material					282.70

D.—SHINGLES (INCLUDING STARTER STRIPS)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8–6	1	½	$2.75	$1.38
Carpenter, skilled	8–6	3	14¼	2.50	35.63
Laborer, unskilled	8–6	1	5	1.85	9.25
Carpenter, skilled	8–7	3	23	2.50	57.50
Laborer, unskilled	8–7	1	6	1.85	11.10
Total labor					114.86

Material	Date	Amount in units	Amount used	Price per unit	Cost
30# felt	8–4	3 rolls		$3.70	$11.10
# flat tin caps	8–4	20#		.24	4.80
19″ selvage roofing	8–5	28 rolls	14 sq.	2.80	78.40
15# felt	8–6	2 rolls		3.70	7.40
Galvanized "T" starter strip.	8–6	160 lin. ft.		.09	14.40
Black plastic mastic	8–6	5 5-gal. cans	25 gal.	3.60	18.00
Tin caps	8–7	20#		.24	4.80
Plastic mastic	8–7	1 5-gal.	5 gal.	3.60	3.60
Do	7–25	1 5-gal.	5 gal.	3.60	3.60
19″ selvage roofing	8–7	2 rolls	1 sq.	2.85	5.70
26 galvanized flashing	8–6	19 lin. ft.	19 lin ft.		3.00
Total material					154.80
Total labor and material					269.66

Component 8.—Exterior Trim

COMPONENT 8.—EXTERIOR TRIM (HOUSE B)

A.—SOFFIT

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8–6	2	1½	$2.50	$3.75
Do	8–11	2	5½	2.50	13.75
Do	8–13	2	2	2.50	5.00
Do	8–14	2	5½	2.50	13.75
Total labor					36.25

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 8 x 12′ std. shiplap	8–7	24 pcs.	192 bd. ft.	$0.135	$25.92
1 x 8 x 14′ std. shiplap	8–7	10 pcs.	93 bd. ft.	.135	12.56
¾″ quarter round	8–14	169 lin. ft.		.04	6.76
Total material					45.24
Total labor and material					81.49

B.—FASCIA

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8–6	2	4	$2.50	$10.00
Total labor					10.00

COMPONENT 8.—EXTERIOR TRIM (HOUSE B)—Con.

B.—FASCIA—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ VG fir S4S	8–6	3 pcs.	18 bd ft.	$0.34	$6.12
1 x 6 x 14′ VG fir S4S	8–6	2 pcs.	14 bd. ft.	.34	4.76
1 x 6 x 14′ CVG fir finish	8–6	1 pc.	7 bd. ft.	.34	2.38
Total material					13.26
Total labor and material					23.26

C.—RAKE

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 4 x 16′ std. S4S	8–4	2 pcs.	11 bd. ft.	$0.135	$1.49
1 x 4 x 12′ # 1W. P	8–5	5 pcs.	20 bd. ft.	.24	4.80
Total material					6.29
Total labor (included previously)					None
Total labor and material					6.29

Component 9.—Partitions

COMPONENT 9.—PARTITIONS (HOUSE B)

A.—ALL FRAMING (INCLUDES ALL OPENINGS)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8–15	1	7¼	$2.75	$19.93
Carpenter, skilled	8–15	2	2	2.50	5.00
Carpenter, foreman	8–18	1	2	2.75	5.50
Carpenter, skilled	8–18	3	3¾	2.50	9.38
Carpenter, foreman	8–25	1	2¼	2.85	6.41
Carpenter, skilled	8–25	1	3¼	2.60	8.45
Carpenter, foreman	8–27	1	¾	2.85	2.14
Carpenter, skilled	8–27	1	½	2.60	1.30
Do	8–29	1	1¾	2.60	4.55
Total labor					62.66

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 6 x 16′ No. 1 and 2 fir	8–15	1 pc.	16 bd. ft.	$0.145	$2.32
2 x 4 x 16′ No. 1 and 2 fir	8–15	25 pcs.	267 bd. ft.	.145	38.72
2 x 4 x 14′ No. 1 and 2 fir	8–15	4 pcs.	37 bd. ft.	.145	5.36
2 x 4 x 12′ No. 1 and 2 fir	8–15	2 pcs.	16 bd. ft.	.145	2.32
2 x 4 x 16′ No. 1 and 2 fir	8–29	1 pc.	11 bd. ft.	.145	1.60
4 x 8 x ⅛″ asbestos cement board.	9–3	1 pc.	32 sq. ft.	.11	3.52
1 x 6 x 12′ DWP	9–3	1 pc.	6 bd. ft.	.34	2.04
1 x 10 x 8′ CVG fir	9–3	1 pc.	7 bd. ft.	.42	2.94
4 x 8 x ⅛″ black temp. hardboard.	9–11	1 pc.	32 sq. ft.	.14	4.48
2 x 4 x 10′ No. 1 and 2 fir	9–11	2 pcs.	13 bd. ft.	.145	1.89
1⅜ x 1⅜ corner bead	9–12	20 lin. ft.	20 lin. ft	.18	3.60
4 x 8 x ⅛″ asbestos cement board.	9–12	1 pc.	32 sq. ft.	.115	3.68
2 x 4 x 10′ No. 1 and 2 fir	9–12	4 pcs.	27 bd. ft.	.145	3.92
1 x 6 x 12′ DWP	9–12	1 pc.	6 bd. ft.	.34	2.04
4 x 8 x ½″ plasterboard	9–16	2 pcs.	64 sq. ft.	.065	4.16
Total material					82.59
Total labor and material					145.25

Component 10.—Windows

COMPONENT 10.—WINDOWS (HOUSE B)

A.—SILLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-28	1	1¾	$2.50	$4.30
Laborer, unskilled	7-28	1	1	1.85	1.85
Carpenter, skilled	8-1	4	4¼	2.50	10.63
Laborer, unskilled	8-1	1	¼	1.85	.46
Carpenter, foreman	8-4	1	½	2.75	1.38
Carpenter, skilled	8-4	3	1¼	2.50	3.13
Do	8-11	1	¼	2.50	.63
Total labor					22.38

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ No. 1 W. P	8-11	1 pc.	6	$0.24	$1.44
Total material					1.44
Total labor and material					23.82

C.—STOPS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-13	1	1½	$2.75	$4.12
Carpenter, skilled	8-14	1	1½	2.50	3.75
Carpenter, foreman	8-14	1	¼	2.75	.69
Carpenter, skilled	8-14	1	4¾	2.50	11.88
Laborer, unskilled	8-14	1	1	1.85	1.85
Carpenter, skilled	8-18	1	1½	2.50	3.75
Total labor					26.04

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ No. 1 W. P	8-14	1 pc.	6 bd. ft.	$0.145	$0.87
Total material					.87
Total labor and material					26.91

D.—SETTING FIXED GLASS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Subcontract:					
Carpenter, skilled	8-12	1	1	$2.50	$2.50
Glazier, skilled	8-13	1	2¼	------	------
Do	8-14	1	2	------	------
Do	8-12	1	¼	------	------
Total labor					2.50

Material	Date	Amount in units	Amount used	Price per unit	Cost
Labor and material for setting fixed glass					$157.68
8—12″ x 46″ D. S. B., 3—28″ x 46″ D. S. B., 4—80″ x 46″ crystal, 3-42″ x 46″ crystal.					
Total material					157.68
Total labor and material					160.18

E.—TRIM 1.—INSIDE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-18	1	1	$2.75	$2.75
Carpenter, skilled	8-18	4	12½	2.50	31.25
Carpenter, foreman	8-28	1	2¼	2.85	6.41
Total labor					40.41

COMPONENT 10.—WINDOWS (HOUSE B)—Continued

E.—TRIM I.—INSIDE—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12′ No. 1 W. P	8-16	7 pcs.	42 bd. ft.	$0.24	$10.08
Total material					10.08
Total labor and material					50.49

E.—TRIM 2.—OUTSIDE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-22	2	4¼	$2.50	$10.63
Do	7-23	2	3½	2.50	8.75
Laborer, unskilled	7-23	1	½	1.85	.93
Carpenter, skilled	7-29	1	2	2.50	5.00
Laborer, unskilled	7-29	1	2	1.85	3.70
Carpenter, skilled	8-1	4	4½	2.50	11.25
Laborer, unskilled	8-1	1	1¾	1.85	3.24
Carpenter, foreman	8-4	1	¼	2.75	.69
Carpenter, skilled	8-4	1	2½	2.50	6.25
Do	8-5	2	¾	2.50	1.88
Total labor					52.32

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 18′ No. 1 and 2 fir	7-22	4 pcs.	48 bd. ft.	$0.145	$6.96
2 x 4 x 12′ No. 1 and 2 fir	7-18	4 pcs.	32 bd. ft.	.145	4.64
2 x 4 x 12′ No. 1 and 2 fir	7-22	2 pcs.	16 bd. ft.	.145	2.32
2 x 6 x 14′ No. 1 and 2 fir	7-28	2 pcs.	28 bd. ft.	.145	4.06
2 x 6 x 12′ No. 1 and 2 fir	7-28	3 pcs.	36 bd. ft.	.145	5.22
White primer	7-29	1 gal.	----------	------	5.31
1 x 6 x 12′ std	8-1	3 pcs.	18 bd. ft.	.135	2.43
2 x 4 x 12′ No. 1 and 2 fir	8-13	2 pcs.	16 bd. ft.	.145	2.32
Total material					33.26
Total labor and material					85.58

Component 11.—Wiring

COMPONENT 11.—WIRING (HOUSE B)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Electrician, service and fuse panel			14	------	------
Electrician, wall outlets and switch boxes			2	------	------
Electrician, ceiling outlets			4¼	------	------
Electrician, roughing in			11	------	------
Electrician, installing and connecting duplex outlets, fixtures and switches			8½	------	------
Electrician, special			6	------	------
Total labor (included in subcontract)					

Material	Date	Amount in units	Amount used	Price per unit	Cost
Total subcontract 100 Amp Service					$470.75
Special includes range and electric dryer outlets, medicine cabinet installation, door bell system and telephone raceway.					
Total material					
Total labor and material					470.75

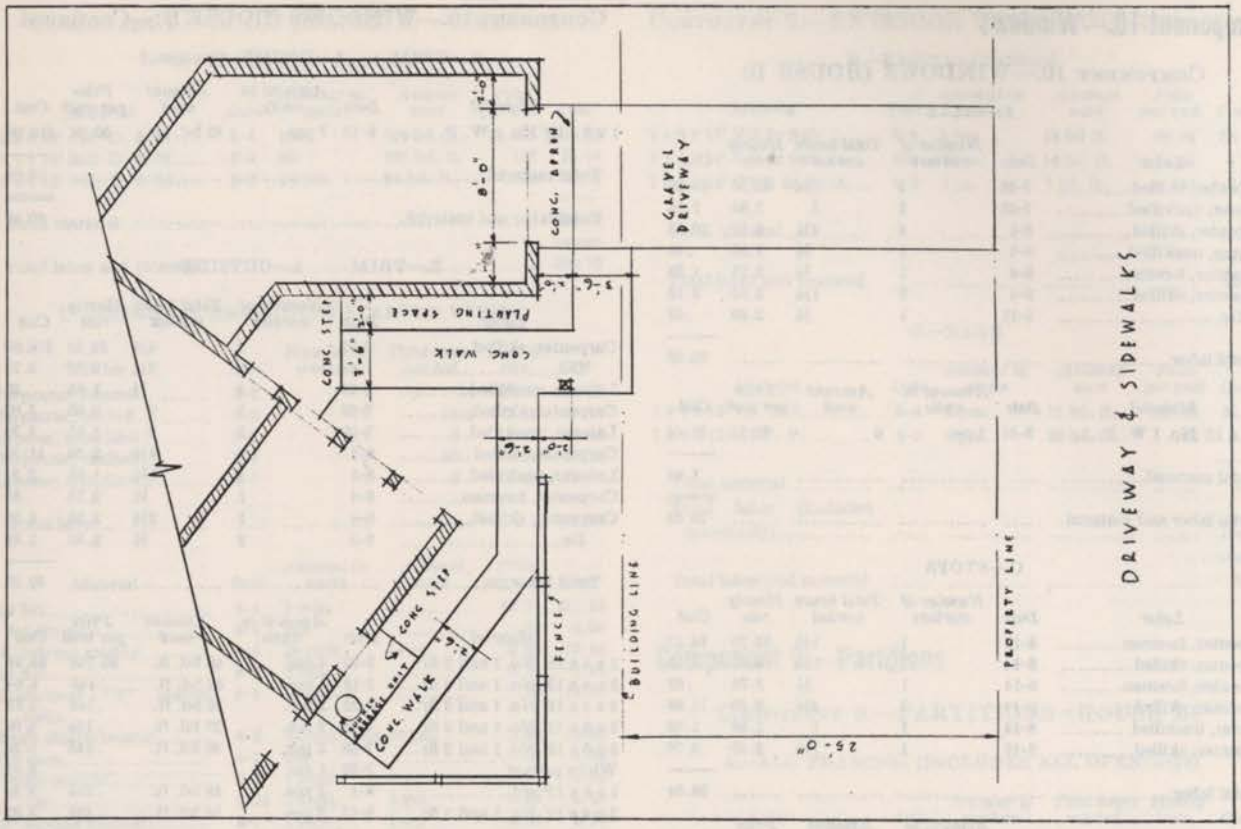


FIGURE 62.—*Driveway and sidewalks—House B.*

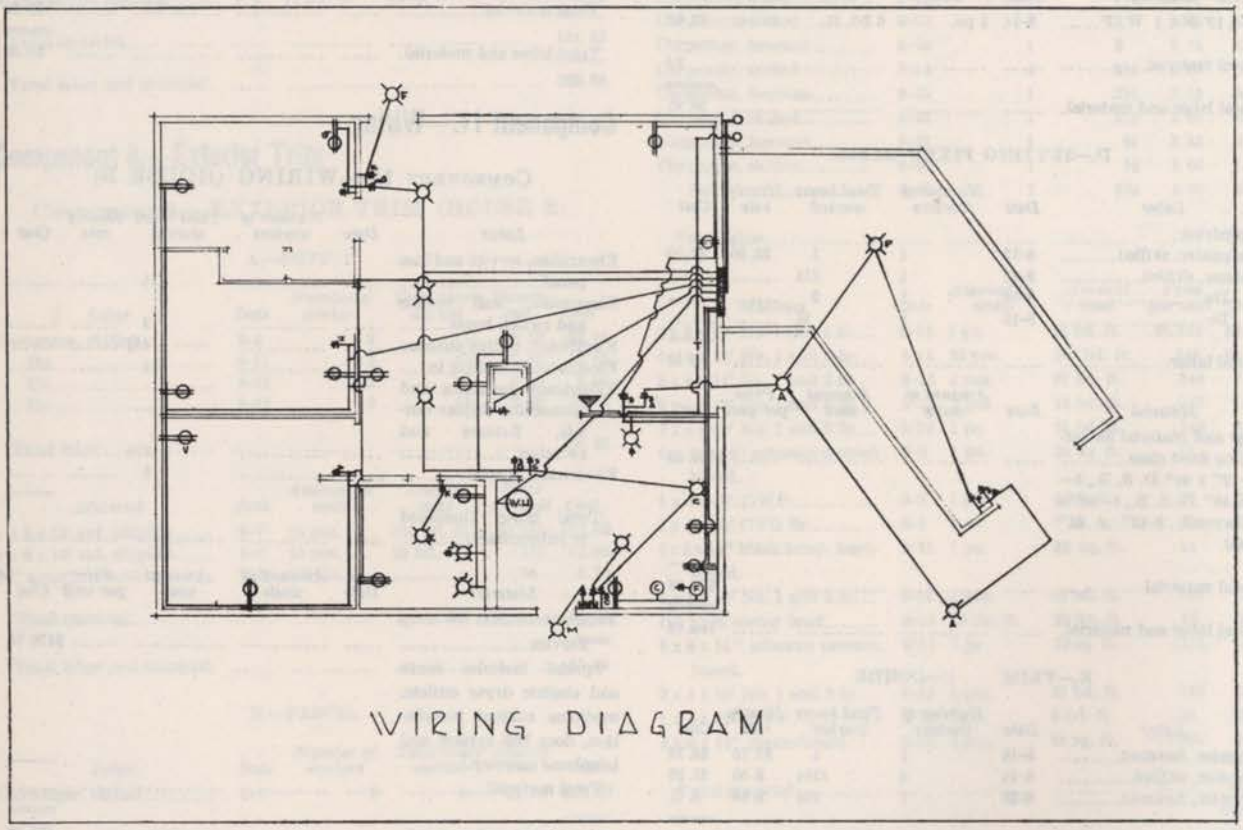


FIGURE 61.—*House B wiring diagram.*

Component 12.—Insulation

Component 12.—INSULATION (HOUSE B)

A.—CEILING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-15	1	1¼	$2.75	$3.44
Carpenter, skilled	8-15	1	1	2.50	2.50
Laborer, unskilled	8-15	1	¼	1.85	.46
Carpenter, skilled	10-2	1	1	2.60	2.60
Total labor					9.00

Material	Date	Amount in units	Amount used	Price per unit	Cost
Full thick 24" insulation batts.	8-13	920 sq. ft.		$0.08	$73.60
23 x 48 full thick batts	10-10	1 bag		.08	6.13
Total material					79.73
Total labor and material					88.73

B.—SIDE WALLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-14	1	3½	$2.50	$8.75
Do	8-15	2	2	2.50	5.00
Total labor					13.75

Material	Date	Amount in units	Amount used	Price per unit	Cost
Semithick insulation batts	8-5	3 sacks	345 sq. ft.	$0.057	$19.67
23 x 48 Semithick insulation batts.	8-13	3 sacks	345 sq. ft.	.057	19.67
Total material					39.34
Total labor and material					53.09

Component 13.—Wallboard

Component 13.—WALLBOARD (HOUSE B)

A.—BACK-UP

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-15	1	2	$2.75	$5.50
Carpenter, skilled	8-15	4	5	2.50	12.50
Laborer, unskilled	8-15	1	1	1.85	1.85
Carpenter, skilled	10-3	1	½	2.60	1.30
Laborer, unskilled	10-13	1	½	1.50	.75
Total labor					21.90

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 16'	8-15	1 pc.	11 bd. ft.	$0.145	$1.55
2 x 4 x 16'	8-15	7 pcs.	75 bd. ft.	.145	10.88
Total material					12.43
Total labor and material					34.33

B.—CEILING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-15	1	2½	$2.75	$6.88
Carpenter, skilled	8-15	2	5	2.50	12.50
Laborer, unskilled	8-15	1	1¼	1.85	2.31
Total labor					21.69

Component 13.—WALLBOARD (HOUSE B)—Continued

B.—CEILING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 12 x ½" plain plasterboard.	8-13	10 pcs.	480 sq. ft.	$0.065	$31.20
4 x 10 x ½" plain plasterboard.	8-13	8 pcs.	320 sq. ft.	.065	20.80
4 x 12 x ½" foilback plasterboard.	8-15	5 pcs.	240 sq. ft.	.07	16.80
Total material					68.80
Total labor and material					90.49

C.—SIDE WALLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-15	1	¾	$2.75	$2.06
Carpenter, skilled	8-15	3	13¼	2.50	33.13
Do	8-18	2	1	2.50	2.50
Total labor					37.69

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 10 x ½" plain plasterboard.	8-13	5 pcs.	200 sq. ft.	$0.065	$13.00
4 x 8 x ½" plain plasterboard.	8-13	10 pcs.	320 sq. ft.	.065	20.80
4 x 12 x ½" foilback plasterboard.	8-15	5 pcs.	240 sq. ft.	.07	16.80
Total material					50.60
Total labor and material					88.29

D.—PARTITIONS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-27	1	3¼	$2.85	$9.26
Carpenter, skilled	8-27	1	3¼	2.60	8.45
Carpenter, foreman	8-28	1	2½	2.85	7.13
Carpenter, skilled	8-28	1	2¼	2.60	5.85
Do	9-15	1	5	2.60	13.00
Do	9-16	1	2¾	2.60	7.15
Do	9-18	1	3	2.60	7.80
Total labor					58.64

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 12 x ½" foilback plasterboard.	8-15	2 pcs.	96 sq. ft.	$0.07	$6.72
4 x 10 x ½" plain plasterboard.	8-15	4 pcs.	160 sq. ft.	.065	10.40
4 x 8 x ½" plain plasterboard.	8-15	4 pcs.	128 sq. ft.	.065	8.32
4 x 12 x ½" foilback plasterboard.	8-18	4 pcs.	192 sq. ft.	.075	14.40
4 x 8 x ½" plain plasterboard.	8-18	16 pcs.	512 sq. ft.	.065	33.28
2½" D. B. Cab. butts	9-15	2 pcs.	2	.55	1.10
Wood pull	9-15	1		.35	.35
4 x 8 x ⅛" temp. hardboard	9-16	1	32 sq. ft.	.14	4.48
Total material					79.05
Total labor and material					137.69

E.—TAPING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Painter, skilled	8-24	2	4	$2.00	$8.00
Painter, apprentice	8-29	1	1½	1.50	2.25
Do	8-30	2	8	1.50	12.00
Do	8-31	1	3	1.50	4.50
Do	9-1	2	10	1.50	15.00
Do	10-7	2	6	1.50	9.00
Carpenter, skilled	10-9	1	4	2.60	10.40
Do	10-13	1	7½	2.60	19.50
Laborer, unskilled	10-13	1	3	1.50	4.50
Total labor					85.15

Component 13.—WALLBOARD (HOUSE B)—Con.

E.—TAPING—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
Joint taping system	8-23	1-25# bag			$4.75
Do	8-30	1-25# bag			4.75
Joint taping cement only	8-30	1-25# bag			3.75
Do	9-2	1-25# bag			3.75
Total material					17.00
Total labor and material					102.15

F.—TRIM

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-28	1	1½	$2.85	$4.28
Carpenter, skilled	8-28	1	¼	2.60	.65
Carpenter, foreman	8-29	1	2	2.85	5.70
Carpenter, skilled	8-29	2	¾	2.60	1.95
Do	9-3	2	3	2.60	7.80
Do	9-10	1	1	2.60	2.60
Do	9-11	1	7½	2.60	19.50
Do	9-13	3	9¼	2.60	24.05
Do	9-18	1	1	2.60	2.60
Do	9-26	1	2	2.60	5.20
Do	10-9	1	2	2.60	5.20
Total labor					79.53

Material	Date	Amount in units	Amount used	Price per unit	Cost
Base trim	8-18	54 lin. ft.		$0.11	$5.94
2¼" base trim	8-19	42 lin. ft.		.11	4.62
¾" quarter round	8-19	156 lin. ft.		.04	6.24
1 x 6 x 12' No. 1 W. P	8-28	1 pc.	6 bd. ft.	.24	1.44
2" casing	8-29	150 lin. ft.		.11	16.50
1 x 6 x 12' No. 1 W. P	8-29	1 pc.	6 bd. ft.	.24	1.44
10'-2" casing	9-3	4 pcs.	40 lin. ft.	.11	4.40
2¼" casing	9-5	150 lin. ft.		.11	16.50
2¼" base trim	9-12	20 lin. ft.		.11	2.20
½" quarter round	9-12	32 lin. ft.		.04	1.28
Do	9-22	8 lin. ft.		.04	.32
Total material					60.88
Total labor and material					140.41

Component 14.—Doors

Component 14.—DOORS (HOUSE B)

A.—JAMB

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-8	2	9½	$2.50	$23.75
Laborer, unskilled	8-8	1	¼	1.85	.46
Carpenter, skilled	8-11	2	1	2.50	2.50
Carpenter, foreman	8-28	1	½	2.85	1.43
Carpenter, skilled	8-28	1	3	2.60	7.80
Do	8-29	1	1½	2.60	3.90
Total labor					39.84

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 8' C.W.P	7-21	2 pcs.	8 bd. ft.	$0.42	$3.36
¾ x 6 x 14' CWP	8-7	3 pcs.	32 bd. ft.	.45	14.40
¾ x 6 CWP	8-7	18'	13½ bd. ft.	.45	6.08
1 x 4 x 14' CWP	8-28	3 pcs.	14 bd. ft.	.42	5.88
1 x 4 x 14' No. 1 WP	8-28	2 pcs.	9 bd. ft.	.24	2.16
1 x 4 x 14' CWP	8-29	1 pc.	5 bd. ft.	.42	2.10
Total material					33.98
Total labor and material					73.82

Component 14.—DOORS (HOUSE B)—Continued

B.—TRIM

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-11	2	3½	$2.50	$8.75
Do	8-14	2	1½	2.50	3.75
Do	8-28	1	½	2.60	1.30
Carpenter, foreman	8-29	1	2¾	2.85	7.84
Carpenter, skilled	8-29	2	5½	2.60	14.30
Carpenter, apprentice	8-29	1	2	1.50	3.00
Carpenter, foreman	9-2	1	1	2.85	2.85
Total labor					41.79

Material	Date	Amount in units	Amount used	Price per unit	Cost
¾ x 6 x 10' CVG fir	8-11	4 pcs.	6 bd. ft.	$0.45	$2.70
2 x 4 x 16' long	8-14	1 pc	11 bd. ft.	.145	1.60
½ x 1⅜ trim (door stops)	8-19	100 lin. ft.	100 lin. ft.	.11	11.00
1 x 6 x 12' No. 1 WP	8-29	1 pc.	6 bd. ft.	.24	1.44
2" mldg	9-2	60 lin. ft.	60 lin. ft.	.11	6.60
Total material					23.34
Total labor and material					65.13

C.—HANGING (HINGES)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-11	2	6¼	$2.50	$15.63
Laborer, unskilled	8-11	1	¼	1.85	.46
Carpenter, skilled	8-13	1	1	2.50	2.50
Do	9-5	1	5¼	2.60	13.65
Do	9-9	1	2½	2.60	6.50
Do	9-10	1	1¾	2.60	4.55
Do	9-11	1	3¾	2.60	9.75
Do	9-12	1	2½	2.60	6.50
Do	9-15	1	2¾	2.60	7.15
Do	9-26	1	4	2.60	10.40
Total labor					77.09

Material	Date	Amount in units	Amount used	Price per unit	Cost
Spring hinges	8-7	3 pr.	3 pr.	$1.30	$3.90
Threshplates	9-26	3 lin. ft.	3 lin. ft.	.72	2.16
#241 CMD 3½ x 3½ butts	9-10	1½ pr.	1½ pr.	2.10	3.15
#241 CMD 4' x 4' butts	9-10	1½ pr.	1½ pr.	2.20	3.30
Total material					12.51
Total labor and material					89.60

D.—HARDWARE (LOCKSETS)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-28	1	¼	$2.85	$0.71
Carpenter, skilled	9-5	1	½	2.60	1.30
Do	9-11	1	2	2.60	5.20
Do	9-12	1	½	2.60	1.30
Do	9-15	1	1¼	2.60	3.25
Do	10-1	1	1	2.60	2.60
Total labor					14.36

Material	Date	Amount in units	Amount used	Price per unit	Cost
Chain door stops	8-7	3		$0.70	$2.10
Exterior lock	9-12	1		8.14	8.14
Exterior lock—keyed alike	9-12	2		12.50	25.00
Privacy lock—bath	9-12	1		6.50	6.50
Privacy lock—bedroom	9-12	3		6.50	19.50
Aluminum latches	9-12	3 pr.		1.25	3.75
2/8 x 6/8—1⅜" comb. dr. 8 lt.	8-7	2		18.92	37.84
3/0 x 6/8—1⅜" comb. dr. 8 lt.	8-7	1		19.77	19.77
3/0 x 6/8—1¾" birch S/C no lights.	8-28	1		45.00	45.00

COMPONENT 14.—DOORS (HOUSE B)—Continued

D.—HARDWARE (LOCKSETS)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
2/8 x 6/8—1¾" birch S/C no lights.	8-28	2	.....	$40.05	$80.10
2/6 x 6/8—1⅜" std. doors	8-28	1	.....	16.81	16.81
2/4 x 6/8—1⅜" std. flush bir.	9-5	1	.....	14.29	14.29
2/6 x 6/8—1⅜" std. flush bir.	9-5	2	.....	14.88	29.76
Total material	.....	.....	.....	.....	308.56
Total labor and material	.....	.....	.....	.....	322.92

Component 15.—Septic Tanks

COMPONENT 15.—SEPTIC TANKS (HOUSE B)

A.—COMPLETE INSTALLATION

1.—TANK AND DISTRIBUTION BOX

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-20	2	6	$1.85	$11.10
Do	6-19	2	7	1.85	12.95
Do	7-10	3	5½	1.85	10.18
Do	7-14	1	1	1.85	1.85
Total labor	.....	.....	.....	.....	36.08

Material	Date	Amount in units	Amount used	Price per unit	Cost
Septic tank	6-20	1	1	$76.10	$76.10
Distribution box	6-20	1	1	10.00	10.00
Total material	.....	.....	.....	.....	86.10
Total labor and material	.....	.....	.....	.....	122.18

A.—COMPLETE INSTALLATION 2.—FIELD

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	6-23	1	8	$1.85	$14.80
Do	6-24	1	8	1.85	14.80
Do	6-25	1	8	1.85	14.80
Do	6-26	1	8	1.85	14.80
Do	6-27	1	4½	1.85	8.33
Do	7-7	4	21	1.85	38.85
Do	7-8	3	12	1.85	22.50
Do	7-9	4	19	1.85	35.15
Do	7-10	5	6	1.85	11.10
Do	7-11	6	30	1.85	55.50
Do	7-12	4	10¼	1.85	18.96
Machine operator and machine	7-12	1	1	6.00	6.00
Total labor	.....	.....	.....	.....	255.59
Total material	.....	.....	.....	.....	None
Total labor and material	.....	.....	.....	.....	255.59

Component 16.—Cabinets

COMPONENT 16.—CABINETS (HOUSE B)

A.—KITCHEN 1.—BASE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-5	1	4¼	$2.60	$11.05
Carpenter, foreman	9-5	1	1½	2.85	4.28
Carpenter, skilled	9-8	2	14¾	2.60	38.35
Do	9-9	2	5¼	2.60	13.65
Do	9-10	2	9¼	2.60	24.05
Carpenter, apprentice	9-10	1	½	1.50	.75
Total labor	.....	.....	.....	.....	92.13

COMPONENT 16.—CABINETS (HOUSE B)—Continued

A.—KITCHEN 1.—BASE—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 8 x ¾" SIS Int. plywood	9-3	3 pcs.	96 sq. ft.	$0.35	$33.60
2 x 4 x 10' No. 1 and 2 fir	9-4	6 pcs.	40 bd. ft.	.145	5.80
1 x 6 x 12' DWP	9-5	1 pc.	6 bd. ft.	.34	2.04
1 x 6 x 8' CVG fir finish	9-5	2 pcs.	8 bd. ft.	.34	2.72
1 x 4 x 8' CVG fir finish	9-5	2 pcs.	5 bd. ft.	.34	2.04
4 x 8 x ¾" SIS Int. plywood	89-	1 pc.	32 sq. ft.	.35	11.20
1 x 12 x 10' DWP	9-8	2 pcs.	20 bd. ft.	.38	7.60
1 x 6 x 12' DWP	9-8	2 pcs.	12 bd. ft.	.34	4.08
Wood pulls	9-9	5	.....	.30	1.50
Chromium knobs	9-9	5	.....	.25	1.25
Edging	9-9	30 lin. ft.	.....	.23	6.90
26" T molding	9-9	1 pc.	23 lin. ft.	.21	.53
Chrome cove	9-9	16 lin. ft.	.....	.21	3.36
Magnetic catch	9-9	3	.....	.90	2.70
1¼ x 5 OH screws	9-10	1 gro.	.....	.....	1.08
30" x 12' cabinet top covering.	9-10	1 pc.	30 sq. ft.	.89	26.70
Mastic	9-10	1 qt.	.....	1.25	1.25
Total material	.....	.....	.....	.....	114.35
Total labor and material	.....	.....	.....	.....	206.48

A.—KITCHEN 2.—WALL

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	9-9	1	7½	$2.85	$21.38
Carpenter, skilled	9-10	2	16	2.60	41.60
Carpenter, apprentice	9-10	1	½	1.50	.75
Carpenter, foreman	9-26	1	8	2.85	22.80
Carpenter, skilled	9-29	2	9	2.60	23.40
Total labor	.....	.....	.....	.....	109.93

Material	Date	Amount in units	Amount used	Price per unit	Cost
Shelf cleats	8-18	24	.....	$0.10	$2.40
Clips	9-5	28	.....	.03	.84
Shelf track	9-5	20 lin. ft.	.....	.13	2.60
1 x 10 x 10' DWP	9-8	2 pcs.	17 bd. ft.	.35	5.95
1 x 12 x 10' DWP	9-8	2 pcs.	20 bd. ft.	.38	7.60
1 x 12 x 14' CWP	9-9	1 pc.	14 bd. ft.	.45	6.30
Pulls	9-10	7	.....	.05	.35
4 x 8 x ⅛" temp. hardboard	9-11	1 pc.	32 sq. ft.	.11	3.52
Metal trim	9-12	8 lin. ft.	.....	.18	1.44
4 x 8 x ¾" SIS Int. plywood	9-3	2 pcs.	64 sq. ft.	.35	22.40
4 x 8 x ⅜" SIS Int. plywood	9-3	1 pc.	32 sq. ft.	.35	11.20
2 x 4 x 10' No. 1 and 2 fir	9-3	6 pcs.	40 bd. ft.	.145	5.80
E3068 cab. hinge	9-4	12 pcs.	.....	.60	7.20
1 x 8 x 12' CVG fir	9-4	5 pcs.	40 bd. ft.	.34	13.60
E9710 rubber roller catch	9-5	8	.....	.30	2.40
1 x 6 x 8' CVG fir finish	9-5	3 pcs.	12 bd. ft.	.34	4.08
1 x 4 x 8' CVG fir finish	9-5	2 pcs.	5 bd. ft.	.34	1.70
Chrome knobs	9-9	8	.....	.25	2.00
Clips	9-10	16	.....	.03	.48
Shelf track	9-10	1 pc.	2 lin. ft.	.10	.20
Knob	9-10	1	.....	.25	.25
Pulls	9-10	2	.....	.05	.10
Total material	.....	.....	.....	.....	102.41
Total labor and material	.....	.....	.....	.....	212.34

B.—UTILITY

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-9	1	1¼	$2.60	$3.25
Do	9-11	1	½	2.60	1.30
Do	9-26	1	½	2.60	1.30
Total labor	.....	.....	.....	.....	5.85

COMPONENT 16.—CABINETS (HOUSE B)—Continued

B.—UTILITY

Material	Date	Amount in units	Amount used	Price per unit	Cost
E9710 rubber roller catch	9-5	2		$0.30	$0.60
Total material					.60
Total labor and material					6.45

C.—BATH

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-10	1	3¾	$2.60	$9.75
Do	9-11	2	2¼	2.60	5.85
Do	9-12	1	4¾	2.60	12.35
Do	9-15	1	½	2.60	1.30
Do	9-22	1	1	2.60	2.60
Total labor					31.85

Material	Date	Amount in units	Amount used	Price per unit	Cost
Shelf cleats	8-18	4		$0.03	$0.12
4 x 8 x ¾" SIS. Int. plywood	9-11	1 pc.	32 sq. ft.	.35	11.20
Chrome cove	9-12	3 lin. ft.		.21	.63
¾" counter edge	9-12	5 lin. ft.		.24	1.20
Metal trim	9-12	9 lin. ft.		.18	1.62
Chrome knob	9-12	1		.25	.25
1 x 4 x 18' No. 1 WP	9-22	1	5 bd. ft.	.24	1.20
1 x 6 x 12' CWP	9-22	2	12 bd. ft.	.42	5.04
2' x 30" cabinet top covering	9-10	1	5 sq. ft.	.89	4.45
Total material					25.71
Total labor and material					57.59

D.—TELEPHONE RECESS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-15	1	¾	$2.60	$1.95
Do	9-16	1	2¼	2.60	5.85
Total labor					7.80
Total material					None
Total labor and material					7.80

Component 17.—Closet Wall Units

COMPONENT 17.—CLOSET WALL UNITS (HOUSE B)

A.—FRAMEWORK (INCLUDES SHELVES, CLOSET POLE, HANGERS, AND TRIM)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	8-28	1	2½	$2.60	$6.50
Do	8-29	2	2¾	2.60	7.15
Carpenter, foreman	9-2	1	5¾	2.85	16.39
Carpenter, skilled	9-2	2	12¾	2.60	33.15
Do	9-3	2	1½	2.60	3.90
Do	9-5	1	8	2.60	20.80
Do	9-8	1	1¼	2.60	3.25
Do	9-9	2	16	2.60	41.60
Total labor					134.04

Material	Date	Amount in units	Amount used	Price per unit	Cost
Mastic	8-28	1 gal.		$1.80	$1.80
4 x 8 x ⅛" temp. hardboard	8-28	1	32 sq. ft.	.11	3.52
4 x 8 x ½" plasterboard	8-28	2	64 sq. ft.	.065	4.16
1 x 6 x 8' V. G. fir B. & C.	8-28	10 pcs.	40 bd. ft.	.36	14.40
1 x 10 x 8' V. G. fir B. & C.	8-28	9 pcs.	63 bd. ft.	.36	22.68
1⅝" 4" closet pole	8-28	5 lin. ft.	5 lin. ft.	.15	.75

COMPONENT 17.—CLOSET WALL UNITS (HOUSE B)—Continued

A.—FRAMEWORK (INCLUDES SHELVES, CLOSET POLE, HANGERS, AND TRIM)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
1 x 6 x 12' No. 1 WP	8-28	1 pc.	6 bd. ft.	$0.24	$1.44
4 x 8 x ½" plasterboard	8-28	1 pc.	32 sq. ft.	.11	3.52
4 x 8 x ⅛" temp hardboard	8-29	1 pc.	32 sq. ft.	.115	3.68
4 x 8 x ⅛" hardboard	8-29	1 pc.	32 sq. ft.	.11	3.52
1 x 6 x 12' No. 1 WP	8-29	1 pc.	6 bd. ft.	.24	1.44
4 x 8 x ⅛" temp. 2 sides hardboard.	9-2	1 pc.	32 sq. ft.	.12¼	3.92
2 x 4 1 x 0' No. 1 and 2 fir	9-2	3 pcs.	19 bd. ft.	.24	4.56
1 x 6 x 12' CWP	9-2	3 pcs.	12 bd. ft.	.35	6.30
1 x 4 x 14' No. 1 WP	9-2	2 pcs.	9 bd. ft.	.24	2.16
Clips	9-5	32		.03	.96
Shelf track	9-5	32 lin. ft.		.13	4.16
Total material					82.97
Total labor and material					217.01

B.—DOORS 1.—MAKING

Total labor					None

Material	Date	Amount in units	Amount used	Price per unit	Cost
Pulls	9-20	5 pcs.		$0.25	$1.25
Total material					1.25
Total labor and material					1.25

2.—INSTALLATION

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	10-1	1	1¼	$2.60	$3.25
Do	11-1	1	2¾	2.60	7.15
Total labor					10.40

Material	Date	Amount in units	Amount used	Price per unit	Cost
4/0 x 8/0 wooden folding doors.	9-19	5 pcs.		$29.50	$147.50
Pulls, wood	9-19	5 pcs.		.10	.50
Total material					148.00
Total labor and material					158.40

C.—FREE STANDING UNITS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-15	1	3¾	$2.60	$9.75
Do	9-16	2	10¼	2.60	26.65
Do	9-17	1	8	2.60	20.80
Laborer, unskilled	9-17	1	4	1.50	6.00
Carpenter, skilled	9-18	1	4	2.60	10.40
Laborer, unskilled	9-18	1	3¾	1.50	5.63
Carpenter, skilled	9-19	1	4½	2.60	11.70
Do	9-22	1	7	2.60	18.20
Do	9-23	1	5½	2.60	14.30
Do	10-1	1	4	2.60	10.40
Do	10-9	1	2	2.60	5.20
Do	10-10	1	8	2.60	20.80
Total labor					159.83

Material	Date	Amount in units	Amount used	Price per unit	Cost
2 x 4 x 12' No. 1 and 2 fir	9-12	5 pcs.	40 bd. ft.	$0.145	$5.80
1 x 14 x 14' CWP	9-12	2 pcs.	33 bd. ft.	.47	15.51
1 x 12 x 16' No. 1 WP	9-12	9 pcs.	144 bd. ft.	.25	36.00
1 x 8 x 14' No. 1 WP	9-12	9 pcs.	84 bd. ft.	.24	20.16
1 x 8 x 12' No. 1 WP	9-12	12 pcs.	96 bd. ft.	.24	23.04

COMPONENT 17.—CLOSET WALL UNITS (HOUSE B)—Continued

C.—FREE STANDING UNITS—Continued

Material	Date	Amount in used	Amount used	Price per unit	Cost
1 x 6 x 12′ No. 1 WP	9–12	11 pcs.	66 bd. ft.	$0.24	$15.84
1 x 4 x 12′ No. 1 WP	9–12	1 pc.	4 bd. ft.	.24	.96
1 x 4 x 8′ No. 1 WP	9–12	2 pcs.	5 bd. ft.	.24	1.20
½ x 6″ screws	9–12	1 gross		.90	.90
¾ x 6″ screws	9–12	1 gross		.74	.74
Cabinet catches	9–12	2 pcs		.10	.20
Corr. fasteners	9–12	2 boxes		.30	.60
24″ piano hinge	9–12	1 pc.		.125	1.25
4 x 8 x ⅛″ black hardboard	9–12	11 pcs	352 sq. ft.	.14	49.28
Screws	9–16	1 gross		1.50	1.50
⅝ x 5 corrugated fasteners	9–17	4 boxes		.30	1.20
Glue	9–18	1 pt.		.65	.65
⅝ dowel	9–18	1 pc.	3 lin. ft.	.05	.05
1 x 10 x 12′ No. 1 WP	9–18	3 pcs.	30 bd. ft.	.24	7.20
4 x 8 x ⅛″ black hardboard	10–1	4 pcs.	128 sq. ft.	.14	17.92
Sander belts	10–10	3 pcs.		.35	1.05
1 x 10 x 16′ No. 1 WP	10–10	1 pc.	13 bd. ft.	.24	3.12
Total material					204.17
Total labor and material					364.00

Component 18.—Painting

COMPONENT 18.—PAINTING (HOUSE B)

MATERIALS

Material	Date	Amount in units	Amount used	Price per unit	Cost
Total, subcontract					$728.00
Includes labor and material. Two coats of paint applied on both. Exterior and interior and bath tile.					
Total labor and material					728.00

Component 19.—Flue (Prefabricated)

COMPONENT 19.—FLUE (PREFABRICATED) (HOUSE B)

A.—TOTAL TIME FOR INSTALLING FLUE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8–6	1	¼	$2.75	$0.69
Do	8–7	1	2½	2.75	6.88
Carpenter, skilled	8–7	4	2½	2.50	6.25
Carpenter, foreman	8–11	1	¼	2.75	.69
Carpenter, skilled	8–11	1	¼	2.50	.63
Total labor					15.14

Material	Date	Amount in units	Amount used	Price per unit	Cost
Prefabricated flue, assembly complete.					
2/2 ft. sections–1/1 ft. section	8–6	1			$52.50
2 x 4 x 12′	8–7	1 pc.	8 bd. ft.	$0.145	1.16
2′ flue section, prefabricated	8–7	1 pc.	1	8.00	8.00
Total material					$61.66
Total labor and material					76.80

Component 20.—Plumbing

COMPONENT 20.—PLUMBING (HOUSE B)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Under floor and plumbing tree:					
Plumber, skilled			8¼		
Plumber, apprentice			3½		
Laborer, unskilled			6¼		
Water supply and fixture installation:					
Plumber, skilled			13¾		
Plumber, apprentice			5¼		
Laborer, unskilled			9¼		
Total labor					None

Material	Date	Amount in units	Amount used	Price per unit	Cost
Total subcontract: labor and material					$960.50
Double bowl kitchen sink, 5′ bathtub with shower head, 19″ x 21″ built-in lavatory, 52-gal. hot water heater, towel racks, paper holder, soap and grab, shower curtain rod, water closet.					
Total material					
Total labor and material					960.50

Component 21.—Heating

COMPONENT 21.—HEATING (HOUSE B)

MATERIALS

Total subcontract					$596.70
Includes labor and material. Heating unit used was an oil fired, pot type, counter flow, warm air furnace with a B. t. u. rating of 64,000.					
Total labor and material					596.70

Component 22.—Garages

COMPONENT 22.—GARAGES (HOUSE B)

A.—FLOOR

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7–12	3	4½	$1.85	$8.33
Do	7–14	5	15¾	1.85	29.14
Do	7–15	1	2	1.85	3.70
Laborer, skilled	7–15	1	4½	2.00	9.00
Mason, skilled	7–15	2	15	3.25	48.75
Laborer, unskilled	7–16	3	7½	1.85	13.89
Laborer, skilled	7–21	1	3	2.00	6.00
Laborer, unskilled	7–21	3	12½	1.85	23.13
Mason, skilled	7–21	1	3	3.25	9.75
Laborer, unskilled	7–22	1	2	1.85	3.70
Do	7–23	4	14	1.85	25.90
Cement finisher, skilled	7–23	2	3½	2.75	9.63
Cement finisher, apprentice	7–23	1	¼	2.00	.50
Cement finisher, skilled	7–23	2	3	2.75	8.25
Laborer, unskilled	7–28	1	¼	1.85	.46
Do	8–5	1	½	1.85	.93
Mason, skilled	8–5	1	½	3.25	1.63
Do	8–7	1	¼	3.25	.81
Total labor					203.50

COMPONENT 22.—GARAGES (HOUSE B)—Continued

A.—FLOOR—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
8 x 8 x 16 concrete block	7-14	177	177	$0.205	$36.28
4 x 8 x 16 concrete block	7-14	55	55	.195	9.63
Mortar	7-14	5 sacks	5 sacks	1.02	5.10
Concrete 1-3-5	7-14	8160#	2.04 cu. yd.	12.10	24.68
2 x 4 x 12' No. 1 and 2 fir	7-14	3 pcs.	24 bd. ft.	.145	3.48
Gravel	7-16	13 yds.	13 cu. yd.	1.60	20.80
Concrete 1-3-5	7-23	3740#	.935 cu. yd.	12.10	11.31
Do	7-23	12240#	3.06 cu. yd.	12.10	37.03
Brick mortar	7-24	3 sacks	3 sacks	1.20	3.60
Cement	7-11	7 sacks	7 sacks	1.30	9.10
Concrete	7-14	550#	.138 cu. yd.	12.10	1.70
Total material					162.71
Total labor and material					366.21

B.—WALLS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	8-5	1	¾	$1.85	$1.39
Carpenter, foreman	8-6	1	6½	2.75	17.88
Carpenter, skilled	8-6	3	6	2.50	15.00
Carpenter, apprentice	8-6	1	½	1.75	.88
Carpenter, foreman	8-7	1	2½	2.75	6.88
Carpenter, skilled	8-7	2	10½	2.50	26.25
Laborer, unskilled	8-7	2	½	1.85	.93
Carpenter, foreman	8-8	1	2	2.75	5.50
Carpenter, skilled	8-11	1	1¾	2.50	4.38
Laborer, unskilled	8-11	1	¾	1.85	1.39
Carpenter, skilled	8-13	2	4	2.50	10.00
Carpenter, foreman	8-14	1	2	2.75	5.50
Carpenter, skilled	8-14	3	1½	2.50	3.75
Total labor					99.73

Material	Date	Amount in units	Amount used	Price per unit	Cost
½ x 6 machine bolts	7-15	16	16	$0.095	$1.52
2 x 4 x 14' No. 1 and 2 fir	8-5	24 pcs.	224 bd. ft.	.145	32.48
2 x 4 x 16' No. 1 and 2 fir	8-5	5 pcs.	53 bd. ft.	.145	7.69
2 x 4 x 12' No. 1 and 2 fir	8-5	10 pcs.	80 bd. ft.	.145	11.60
2 x 8 x ½" gypsum sheathing	8-5	24 pcs.	384 sq. ft.	.065	24.96
4 x 8 x ⅛" asbestos cement board	8-5	14 pcs.	448 sq. ft.	.115	51.52
1 x 6 x 8' CVG fir	8-7	3 pcs.	12 bd. ft.	.34	4.08
1 x 8 x 8' CVG fir	8-7	3 pcs.	16 bd. ft.	.34	5.44
4 x 8 x ⅛" asbestos cement board	8-7	2 pcs.	64 sq. ft.	.115	7.36
1 x 6 x 12' No. 1 white pine	8-7	1 pc.	6 bd. ft.	.24	1.44
2 x 8 x 16'	8-8	1 pc.	21 bd. ft.	.145	3.00
2 x 4 x 16'	8-12	1 pc.	11 bd. ft.	.145	1.65
2 x 4 x 16'	8-13	1 pc.	11 bd. ft.	.145	1.60
Total material					154.34
Total labor and material					254.07

C.—ROOF (INCLUDING CEILING JOIST, BUILT-UP ROOF, TRIM FOR ROOF)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-7	1	2	$2.75	$5.50
Carpenter, skilled	8-7	2	4	2.50	10.00
Laborer, unskilled	8-7	1	¼	1.85	.46
Carpenter, foreman	8-8	1	3¼	2.75	8.94
Carpenter, skilled	8-8	5	23	2.50	57.50
Laborer, unskilled	8-8	1	1½	1.85	2.78
Carpenter, foreman	8-11	1	1¾	2.75	4.81
Carpenter, skilled	8-11	1	1¾	2.50	4.38
Carpenter, skilled	8-12	2	5	2.50	12.50
Carpenter, foreman	8-13	1	4	2.75	11.00
Carpenter, skilled	8-13	1	4	2.50	10.00
Carpenter, skilled	8-14	3	3¼	2.50	8.13
Total labor					136.00

C.—ROOF (INCLUDING CEILING JOIST, BUILT-UP ROOF, TRIM FOR ROOF)—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
3 x 8 x 12' fir	8-5	1 pc.	24 bd. ft.	$1.50	$3.60
1 x 6 x 12' standard D. M.	8-5	95 pcs.	570 bd. ft.	.135	76.95
19" black selvage roofing	8-5	2 rolls	1 sq.	2.80	5.60
15# Felt	8-5	2 rolls		3.70	7.40
4 x 4 x 14' No. 1 fir	8-5	1 pc.	19 bd. ft.	.15	2.85
2 x 8 x 18' No. 1 and 2 fir	8-5	11 pcs.	264 bd. ft.	.15	39.60
2 x 8 x 16' No. 1 and 2 fir	8-5	1 pc.	21 bd. ft.	.145	3.05
1 x 8 x 12' std. shiplap	8-5	20 pcs.	160 bd. ft.	.135	21.60
19" black selvage roofing	8-7	6 rolls	3 sq.	2.80	16.80
Plastic Mastic	8-7	2-5 gal.	10 gal.	3.60	7.20
¾" quarter round	8-14	81 lin. ft.	81 lin. ft.	.04	3.24
2 x 4 x 16'	8-8	1 pc.	11 bd. ft.	.145	1.60
1 x 10 x 14' CVG fir	8-8	3 pcs.	35 bd. ft.	.34	11.90
1 x 10 x 20' CVG fir	8-8	1 pc.	17 bd ft.	.34	5.78
1 x 10 x 18' CVG fir	8-8	1 pc.	15 bd. ft.	.34	5.10
"T" starter strip	8-11	70'	70 lin. ft.	.09	6.30
Black selvage roofing	8-14	1 roll	½ sq.	2.80	2.80
Total material					221.37
Total labor and material					357.37

D.—DOORS AND WINDOWS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	8-8	1	¼	$2.75	$0.69
Carpenter, skilled	8-8	5	5	2.50	12.50
Do	8-11	3	11¾	2.50	29.38
Laborer, unskilled	8-11	1	2¼	1.85	4.16
Carpenter, skilled	8-12	2	10	2.50	25.00
Do	8-13	2	1½	2.50	3.75
Do	8-15	1	2¾	2.50	6.88
Do	9-29	1	2	2.60	5.20
Do	10-1	1	¾	2.60	1.95
Total labor					89.51

Material	Date	Amount in units	Amount used	Price per unit	Cost
Overhead garage door unit	8-7	1			$52.00
4 x 8 x ⅛" temp. hardboard	8-7	2	64 sq. ft.	$0.11	7.04
3/0 x 6/8 x 1⅜"—2 pan. drive	8-7	1			20.00
6/4 x 6 x 14' CWP	8-7	1 pc.	10 bd. ft.	.45	4.50
6/4 x 6 CWP	8-7	6'	4½ bd. ft.	.45	2.02
3½ x 3½ D. B. butts	8-8	1½ pr.		.70	1.05
Exterior lock	8-8	1			4.80
2 x 4 x 12'	8-13	1 pc.	8 bd. ft.	.145	1.16
Total material					92.57
Total labor and material					182.08

Component 23.—Walks and Drives

COMPONENT 23.—WALKS AND DRIVES (HOUSE B)

A.—WALKS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-28	1	¾	$1.85	$1.39
Carpenter, skilled	7-31	2	6¾	2.50	16.88
Laborer, unskilled	7-31	1	1	1.85	1.85
Carpenter, skilled	8-1	1	½	2.50	1.25
Laborer, unskilled	8-1	1	½	1.85	.93
Do	8-8	1	½	1.85	.93
Carpenter, skilled	8-11	1	1½	2.50	3.75
Laborer, unskilled	8-11	1	3	1.85	5.55
Cement finisher, skilled	8-12	2	6	2.75	16.50
Laborer, unskilled	8-13	1	1	1.85	1.85
Total labor					50.88

COMPONENT 23.—WALKS AND DRIVES (HOUSE B)—Continued

A.—WALKS—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
Gravel	7-15	5 cu. yd.	5 cu. yd.	$1.60	$8.00
#1-3-5 concrete	8-9	8350#	2.09 cu. yd.	12.10	25.26
2 x 4 x 12'	8-11	1 pc.	8 bd. ft.	.145	1.16
Total material					34.42
Total labor and material					85.30

B.—DRIVES

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	7-15	2	2½	$1.85	$4.63
Do	7-16	4	3½	1.85	6.48
Do	8-21	1	2¼	1.50	3.38
Do	8-25	1	2½	1.50	3.75
Do	10-11	1	1	1.50	1.50
Total labor					19.74

Material	Date	Amount in units	Amount used	Price per unit	Cost
Gravel	7-15	10 cu. yd.	10 cu. yd.	$1.60	$16.00
Do	7-16	4 cu. yd.	4 cu. yd.	1.60	6.40
Do	8-22	5 cu. yd.	5 cu. yd.	1.60	8.00
Concrete culvert 8" x 3'	8-22	5 pcs.	15 lin. ft.	.85	12.75
White rock	10-11	11,600#	5.8 cu. yd.	2.90	16.82
Total material					59.97
Total labor and material					79.71

C.—STOOPS

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	7-28	3	3½	$2.50	$8.75
Carpenter, unskilled	7-28	2	1	1.75	1.75
Carpenter, skilled	7-29	2	1	2.50	2.50
Laborer, unskilled	7-29	3	3	1.85	5.55
Cement finisher, skilled	7-30	1	1½	2.75	4.13
Carpenter, skilled	7-31	2	1	2.50	2.50
Do	8-1	1	¼	2.50	.63
Cement finisher, skilled	8-12	2	1	2.75	2.75
Total labor					28.56

Material	Date	Amount in units	Amount used	Price per unit	Cost
Concrete 1-3-5	7-30	6,000#	1.5 cu. yd.	$12.10	$18.15
2 x 6 x 14' No. 1 and 2 fir	7-30	3 pcs.	42 bd. ft.	.145	6.09
1 x 8 x 14' T. & G.	7-30	5 pcs.	47 bd. ft.	.145	6.35
Concrete 1-3-5	8-9	1970#	.49 cu. yd.	12.10	5.96
Total material					36.55
Total labor and material					65.11

E.—FENCE

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, foreman	9-4	1	3¾	$2.85	$10.69
Carpenter, skilled	10-1	1	2	2.60	5.20
Do	10-2	2	15	2.60	39.00
Laborer, unskilled	10-2	1	5	1.50	7.50
Do	10-11	2	4	1.50	6.00
Painter (subcontract)	-----	2	4	-----	8.00
Total labor					76.39

COMPONENT 23.—WALKS AND DRIVES (HOUSE B)—Continued

E.—FENCE—Continued

Material	Date	Amount in units	Amount used	Price per unit	Cost
4 x 8 x ⅛" temp. hardboard	9-3	5 pcs.	160	$0.11	$17.60
4 x 4 x 14' No. 1 fir	9-3	1 pc.	93 bd. ft.	.155	2.95
2 x 4 x 16' No. 1 and 2 fir	9-3	12 pcs.	128 bd. ft.	.145	18.56
2 x 6 x 16' No. 1 and 2 fir	9-3	1 pc.	16 bd. ft.	.145	2.32
2 x 6 x 14' No. 1 and 2 fir	9-3	2 pcs.	28 bd. ft.	.145	4.06
2 x 4 x 12' No. 1 and 2 fir	9-3	7 pcs.	84 bd. ft.	.145	8.12
Outside white	9-10	1 gal.	-----	5.90	5.31
1-3-5 concrete	10-2	1920#	.48 cu. yd.	12.10	5 81
4 x 8 x ¼" SOIS-Exterior gr. fir ply.	10-13	3 pcs.	96 SF	.16	16.32
Total material					81.05
Total labor and material					157.44

Component 24.—Rough Grading

COMPONENT 24.—ROUGH GRADING (HOUSE B)

A.—ROUGH

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Machine operator and machine	7-12	1	1	$6.00	$6.00
Do	8-8	1	2½	6.00	15.00
Laborer, unskilled	8-8	1	¾	1.85	1.39
Machine operator and machine	8-8	1	½	6.00	3.00
Laborer, unskilled	8-11	1	½	1.85	.93
Do	9-11	2	3¼	1.50	4.88
Total labor					31.20

Material	Date	Amount in units	Amount used	Price per unit	Cost
Earth fill	6-27	2 loads.	-----	$1.00	$2.00
Do	6-28	8 loads.	-----	1.00	8.00
Earth, top soil	10-7	13 loads.	-----	-----	-----
Truck, rental	10-7	7 hours.	-----	-----	27.00
Tractor	-----	-----	-----	-----	15.00
Total material					52.00
Total labor and material					83.20

B.—FINISH (INCLUDING SEEDING)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	10-7	1	4	$1.50	$6.00
Do	10-8	2	8	1.50	12.00
Do	10-9	2	10	1.50	15.00
Do	10-11	1	1	1.50	1.50
Machine and operator	-----	-----	-----	-----	30.00
Total labor					64.50

Material	Date	Amount in units	Amount used	Price per unit	Cost
Lawn seed, University mix	-----	25#	-----	-----	$17.50
Lawn fertilizer	-----	100#	-----	-----	3.25
Total material					20.75
Total labor and material					85.25

Component 27.—Storm Windows

COMPONENT 27.—STORM WINDOWS (HOUSE B)

A.—PRECUTTING, ASSEMBLY AND FITTING

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Carpenter, skilled	9-29	1	3	2.60	$7.80
Do	9-30	1	1½	2.60	3.90
Do	9-30	2	6½	2.60	16.90
Total labor					28.60

Material	Date	Amount in units	Amount used	Price per unit	Cost
"L" braces	9-26	54 pcs.	54 pcs.	$0.04	$2.16
1 x 8 x 8' CWP	9-26	4	21½ ft.	.42	9.03
1 x 8 x 8' CWP	9-30	½	2½ ft.	.45	1.13
"L" braces	9-30	18	18	.04	.72
All glass DSB					102.00
Total material					115.04
Total labor and material					143.64

Component 30.—Miscellaneous

COMPONENT 30.—MISCELLANEOUS (HOUSE B)

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Laborer, unskilled	8-4	1	1	$1.85	$1.85
Do	8-7	1	1¾	1.85	3.24
Do	8-8	1	4	1.85	7.30
Do	8-11	1	3¾	1.85	6.94
Carpenter, skilled	8-13	2	½	2.50	1.25
Laborer, unskilled	8-13	1	3¾	1.85	6.94
Do	8-14	1	3	1.85	5.55
Carpenter, skilled	8-15	1	¼	2.50	.63
Laborer, unskilled	8-15	1	1½	1.85	2.78
Carpenter, foreman	8-18	1	½	2.75	1.38
Laborer, unskilled	8-19	1	2	1.50	3.00
Do	8-20	1	½	1.50	.75

COMPONENT 30.—MISCELLANEOUS (HOUSE B)—Con.

Labor	Date	Number of workers	Total hours worked	Hourly rate	Cost
Cement finisher, unskilled	8-20	1	1	$1.50	$1.50
Laborer, unskilled	8-25	1	1	1.50	1.50
Do	8-27	1	1¼	1.50	1.88
Do	8-28	1	2	1.50	3.00
Do	8-29	1	¾	1.50	1.14
Do	9-4	1	1½	1.50	2.25
Do	9-8	1	1¼	1.50	1.88
Do	9-9	1	½	1.50	.75
Do	9-10	1	2¼	1.50	3.38
Do	9-11	1	3½	1.50	3.75
Carpenter, skilled	9-12	2	½	2.60	1.30
Do	9-15	1	¼	2.60	.65
Laborer, unskilled	9-18	1	¼	1.50	.38
Total labor					64.97

Material	Date	Amount in units	Amount used	Price per unit	Cost
Twine	7-9	3 balls		$0.30	$0.90
12" trowel	7-19	1		5.10	5.10
Garbage receiver	7-30	1			13.80
Boiled linseed oil	7-29	1 gal.			2.85
Rfg. nails	7-31	2-10# ctns.	20#	2.00	4.00
7d galvanized nails	7-31	10#		.16	1.60
No. 4d finishing nails (2 ctns.)	8-5	20#		.80	1.60
No. 2 R/C shingles	8-6	1 bundle		3.25	3.25
Finishing nails	8-16	#10d		.14	1.40
2 x 8 x 16'	8-18	4 pcs.	85 BF	.145	12.33
1 x 8 x 12' std. S/L	8-18	2 pcs.	16 BF	.135	2.16
1 x 6 x 12' T. & G	8-18	11 pcs.	66 BF	.135	8.91
House numbers	8-28	3		.10	.30
Final power bill	8-28	1			.88
No. 3 R/C shingles	8-29	1 bundle			2.75
Brads	8-29	2 boxes		.12	.24
16d finishing nails	9-3	5		.14	.70
Staples	8-19	½ box		3.50	1.17
Water putty	10-10	1 can	1	.25	.25
Total material					64.19
Total labor and material					129.16

PART VI

GENERAL OBSERVATIONS AND CONCLUSIONS

Working Drawings

The new concept of working drawings quickly conveys information to persons unfamiliar with blueprints.

Specifications on the working drawings save time for the following reasons: One less item for the contractor to have on the job; less chance for error since mechanics have access to prints at all times; step-by-step procedure is helpful in planning and scheduling of work.

Foundation and Concrete Slab

The foundation detail is adaptable to poured concrete walls, block walls, or a combination of the two.

Installation time is reduced for the perimeter insulation by eliminating the cutting operation.

Insulation is held in place without the use of adhesives or other special devices.

The top of the foundation forms a highly acceptable exterior appearance.

The foundation forms a firm screeding surface while pouring the concrete slab.

The radial perimeter warm-air system results in economical heating cost plus warm floors.

The entire foundation and floor slab cost is 12¼ percent of the final house cost.

Precutting

All materials occurring in quantities of a specific dimension can be precut before the assembly begins. This reduces set-up time on the saws; insures that the correct amount of material will be on hand when assembly begins; and forms a controlled operation resulting in a better finished product. Precutting can be done during inclement weather or as fill-in work for the crew.

Use of Jigs

It is recommended that jigs be used wherever possible, regardless of the size of the project. The jig promotes accuracy in dimensioning, reduces the amount of labor expended by the craftsman, and insures quality workmanship.

Wall Assembly and Tip-Up

Sub-assemblies should be fabricated on the jig table in any wall-framing system that uses them. Here again, controlled operation results in a better finished product. Quality lumber should be used.

The entire wall sections should be completed on the floor slab before being tipped into place. This includes framing, sheathing, siding, and trim. Erection costs are reduced by this method.

Complete preassembly is desirable from a safety point of view, as well as cost, since scaffolding is eliminated.

The completed walls in place, as described here, represent a cost of approximately 6 percent of the total house cost, an average of $597 for the two houses, or 58¢ per square foot.

NOTE.—Costs were verified by another contractor's operation in a different State where two houses, identical to the two described in the report, were built. House A was built with only wall framing being prefabricated on the floor before tip-up. Sheathing, siding, trim, and so forth, were applied from scaffolds and ladders. On his second house, the contractor followed the procedure described here, using his same crew of workmen. In so doing, a total of 135½ man-hours were saved.

Trusses

Use of roof trusses provides ease of erection.

With wall and truss tip-ups, it is possible to enclose a structure of a thousand square feet within approximately 7 days with a crew of 5 men.

Trusses should be built in a jig to insure accuracy and controlling of bowed and twisted mate-

rials. If no other place is available, hold blocks in place on slab floor with concrete nails.

Subassemblies should be made if possible.

The truss design and assembly method used on House A are not recommended. Difficulty was experienced in holding the members in place until adequate nailing was done. This resulted in some bottom chords being out of line when the truss was in place on the wall.

The truss, as used in House B, is recommended. It lends itself to subassemblies, is easily transported in that form, and is easy to fabricate.

Placing trusses in place by the tip-up method reduces cost and promotes safety.

Truss cost in place is 3¼ percent of the total house cost. Complete cost of trusses, gable end, sheathing, and roofing is 10 percent of the finished house cost.

Gable End

Gable ends should be complete with finish material before being placed. A study conducted by the Small Homes Council in 1950 revealed that 12 man-hours were saved by following this procedure. The out-of-state contractor used 35 more man-hours by applying the finish material after the gable ends were in place.

Ventilating Louvers in Gable Ends

The ventilating louvers proved to be very costly, and difficult to fabricate and install. They are not recommended. Further studies are being made.

Plumbing

When the roughing-in beneath the slab was done, a mistake was made in permitting the plumber to extend the underground plumbing lines in excess of 4″ above the floor-line. As a result, one wall had to be built in two sections, and it was necessary to work over and around the pipes. This increased the hazard of broken pipes.

Closet Wall Units

Units, as used, are simple to construct. Low-cost construction is possible.

Easy access to entire closet is possible since units are designed with full-front openings.

Quality material should be used.

Free-Standing Storage Units

It is extremely difficult to fabricate on the job, acceptable free-standing storage units. Higher quality materials than those used would have achieved a better-looking and functioning unit. The large doors should be restudied.

Outstanding features of these units are the added storage space, their movability, and the complete absence of a permanent wall at that location.

Trim

If the interior and exterior trim are studied very carefully during the design stage of the project and a simple design is chosen, the contractor can make this trim on the job at a saving. Trim occurs in such small quantities that mill set-up time would equal more than the cost of job-made trim

The only trim purchased for the demonstration house project was ceiling mold, base mold, door stops, and quarter round.

Tools

Observations were made throughout the demonstration house project in regard to the usage of power equipment. Items of power equipment furnished by the contractor were: a radial-arm one hp. saw with extension table; an 8-inch, one-half hp. joiner; an 8-inch electric handsaw; sanders; and a trimmer. These items were on the job at all times. It was noted that as the project progressed, the carpenters, without any direction from the contractor, used the power saw and joiner on a continuing basis. The only times handsaws were used were: (1) when the saw was set up for a particular operation; (2) when the saw was in use by another member of the crew; or (3) when only very small cuts (base and ceiling trim, door trim, etc.) were made.

It is recommended that power equipment be used whenever possible.

No evidence was found that a controlled study has been made on identical houses, one being built with power equipment of a given nature, and one without. However, it is the opinion of the authors that an $800 investment in power equipment could be absorbed into a four-house operation.

APPENDIX A

Preparatory Investigations for Dwelling Design

NOTE.—Preliminary to determining the type of houses to be built for the demonstration, current family living requirements and efficient construction methods were analyzed. This material, it is believed, is of such general value and interest as to warrant the inclusion of a digest of findings as a part of the report. These data are given in Appendices A and B.

I. New Ways of Living Require New Planning and Construction Methods

The problem of designing a small house today is quite different from that of a generation ago. Social, economic, and technological changes have combined to make obsolete houses which were accepted as adequate 25 years ago.

New concepts of comfort and convenience have created a demand for mechanical equipment and household aids. This demand has been further stimulated by a decline in the number of domestic workers. The servantless house has become a necessity. Covering everything from small appliances to heating and cooling systems, this demand for mechanical household aids is almost unlimited. Mechanical refrigerators, ranges, washers, dryers, ironers, dishwashers, vacuum cleaners, toasters, coffee makers, and food mixers have been developed and improved to a high degree of efficiency. These and others, together with radio, television, and improve heating and air cooling systems, have added new complexities to the wiring and plumbing systems, creating demands for additional space. With the cost of space always at a premium, the problem of providing needed and desired facilities and space for their use, as well as to meet other needs of family living, becomes increasingly difficult.

ECONOMIC CHANGES.—The first approach to cost reduction, to maintain a price within the market, was by an overall reduction in the floor area of the house. This automatically reduced the amount of material and labor involved. Size reduction was at first accomplished by making each room somewhat smaller than before, thus creating a miniature replica of a larger house. Carried beyond a certain point, this process results in cramped, unsatisfactory living quarters with considerable waste space and rooms too small to be completely usable. The problem then becomes one, not of further space reduction, but of the redistribution of space and material for fullest usefulness. Builder and homeowner alike have been forced to reassess housing values in terms of performance and to eliminate all unnecessary items and procedures. This has resulted in the development and application of new standards and methods of planning and construction.

SOCIAL CHANGES.—The development of new planning techniques has been strongly influenced by changes in social standards and ways of living. Increased informality of living patterns has changed the emphasis of house planning from one of social prestige to one of personal comfort. The living room, which used to be thought of in terms of the 19th century formal parlor, a place to be kept in order at whatever expense to the comfort of the family, is now planned primarily for family activities. The separate dining room, which was useful mainly for formal and holiday dinners, has now been almost universally supplanted by the dining alcove or ell, or even an undefined space within the living room. And, perhaps most significant of all, the kitchen has become, more and more, a center of family living rather than an isolated room which was considered socially unpresentable.

The reasons for this change of emphasis are many and difficult to isolate. Certainly, in this case, unless the housewife is willing to reduce herself completely to the role of servant, particularly when guests are present, she must force social acceptance of the kitchen. In addition to this, however, there seems to be an increasingly

objective attitude towards the social customs and taboos of the previous generation. The idea, for example, that the entertainment of guests must involve days of preparation and an expense disproportionate to the normal standard of living has given way to a more natural, informal attitude that guests should partake of family life more or less as it actually exists. This attitude probably is derived, at least in part, from the absence of any household help. This situation has produced a strong demand for houses which are easy to care for and which are designed for efficiency of operation, as well as for mechanical housekeeping aids. Compactness of plan has become a virtue for the first time, and the one-story house has grown in popularity. The necessity for supervising small children while attending to other tasks has made desirable an increased attention to the space needs of children, and the very compactness of the house has made necessary a more careful study of areas and activities within the house.

Technological Changes.—Another factor which has had a tremendous effect on housing is the widespread ownership of automobiles. Increased mobility has made possible the dispersal of city workers to suburban areas, and the building up of substantial suburban communities. It is not uncommon to find a family living in one area and working, shopping, and spending leisure time in other areas separated by many miles. This loosening of community ties is reflected to some extent also in a decline of the home as the main center of family life. In an effort to counteract this process, there is currently an increased emphasis on planning the home to provide adequately for family recreation and make it an attractive center for activities. The automobile has also had an effect on the physical aspect of houses. The garage has become almost an integral part of the house and is no longer hidden as an eyesore in a rear corner of the lot. Further, the clogging of even residential streets with motor traffic has led to an emphasis on turning one's back on the street, both for privacy and for the safety of children.

In addition to these physical aspects, the automobile has played a part in the creation of an attitude of receptivity to change. Not only is it easier to travel and see a wider variety of things, but also the constant changes and improvements in mechanical design lead logically to the conclusion that changes are desirable and improvement possible in other fields of design as well. The absence of rigid ties to one's community has led to a de-emphasis of permanence in housing in the sense of establishing a homestead for future generations. Today the search for security and permanence is thought of in relative rather than in absolute terms, and there is, therefore, a certain freedom from the standards of "tried and true." This attitude, to be sure, is not universal on the part either of builder or of consumer. However, as the pressure of rising prices increases, complicated by material restrictions and shortages of skilled labor, there is a growing need for the adoption of design and construction procedures which will economize on space use, amounts of material and labor time. Some techniques have already been discovered and tested with satisfactory results.

II. New Planning Techniques

The basic steps in planning a house are the determination of a general area and shape. These are closely associated and have a direct bearing on the final cost and general overall economy of the house.

Through experience it has been found that a one-story, two-bedroom house of from 800 to 1,000 square feet in floor area, or a one-story, three-bedroom house from 1,000 to 1,200 square feet in floor area, afford maximum livability in relation to overall cost. Houses below these general limits sacrifice a degree of livability, while houses which exceed these figures use more space than is necessary for comfortable living.

A rectangular-shaped house, approaching as nearly as possible a square, has been generally accepted as the most economical type of house. A square will contain a maximum floor area with a minimum amount of foundation wall. For example, two houses may contain the same floor area—1,024 square feet—but one may be a square, 32′–0″ by 32′–0″, and the other a long, narrow rectangular, 16′–0″ by 64′–0″. Of the two, the square house will require 32′ less of perimeter wall which indicates a substantial saving. It is not always possible to approach the square in plan, but a simple, rectangular outline will always afford economy. Irregular plans with several projecting wings complicate not only the foundation wall but also the details of exterior walls and roof.

Within limitations of size and shape, a great deal of freedom in space planning is possible. Three general types of planning techniques have been developed in answer to changing housing needs: (1) those which constitute an overall approach to space use; (2) those which establish standards for judging the efficiency and livability of the plan; and (3) those which constitute organized systems of planning, taking into account both spatial and structural considerations.

Overall Approaches to Space Use.—*Activity Zoning.*—Zoning within a house affects only the general disposition of space elements. The objective of zoning is to insure maximum livability by grouping related activities so that they may be carried on without interfering with activities of dissimilar nature.

Household activities may be classified generally as quiet or noisy activities. Rooms or areas devoted to one type of activity should be isolated as much as possible from others of different character. For example, kitchens and children's play areas fall generally into the category of noisy activities and should be isolated from bedroom or quiet study areas which are likely to be in use at the same time.

In large houses, a common means of isolation of areas is to place them on separate floors or to incorporate them into separate wings closed off by doors or by a neutral area, such as an entrance hall or dining area. Usually this is not possible in a small, compact house, but an approach to isolation can be made by the judicious use of hallways or baffle partitions.

An awareness of the benefits of activity zoning may forestall many inconveniences of household operation, such as the necessity for children to do homework in the living room while adults are conversing, or the interference of adult recreational activities with small children who are trying to sleep.

Open Planning.—The technique of open planning is aimed at increasing the apparent use of interior spaces of a house. This is accomplished by area planning a series of activity areas, each of which borrows space, either actual or visual, from adjacent areas. Doors are kept to a minimum. Demarcations are made by baffle partitions or semipartitions. Complete privacy is provided only in bedrooms and bathrooms.

The result is that each individual area (living, dining, kitchen, recreation, etc.) appears to be larger, and, in a sense, actually becomes larger since related activities can overflow from one space to another, allowing dual use of space. At the same time, open planning accomplishes savings in materials and labor through the elimination of doors and door framing and the reduction in quantity of interior partitions.

Open planning, widely used in large custom-built houses, is particularly desirable in a small house where floor area is at a premium. A simple example is the elimination of the separate dining room in favor of a living-dining area. In many instances the principle has seldom been carried further than this. A logical extension of the technique would include the concept of a living-dining-kitchen-play area, parts of which are separated visually by baffles or by storage partitions which may be less than full ceiling height.

Multipurpose Rooms or Areas.—Multipurpose rooms are almost a corollary of open planning. The technique of designing for multipurpose areas like open planning, has the objective of giving one the sense or feeling of more interior space than is actual, plus the aim of permitting the fullest activity use of all available floor area.

The first step in this planning technique is to analyze and classify household activities in order to assign them to areas that are related. Certain major activities usually determine the basic outline of the plan, such as cooking, sleeping, bathing, laundering, dining, conversational activities, etc. In addition to these, there are specialized activities which, in a small house, are seldom assigned individual areas. These include studying, household repairs, account keeping, letter writing, sewing, hobby activities and indoor play for small children.

Generally, in small house plans, most of these secondary activities apparently are not considered since no special facilities are provided for them, such as storage space or work surface. The living room usually bears the brunt of such inadequate planning. While providing one large area for many of these activities and their equipment, this room also is usually considered to be an area which should be kept in reasonably good order for entertaining guests.

One solution to this problem, without increasing the overall area of the house, is to plan several multipurpose areas with proper facilities for each activity. For example, study activities can be assigned to bedrooms; sewing activities to a general work area. Some other combinations are:

bedroom-play area, bath-laundry, sewing-laundry, kitchen-play area, kitchen-laundry, kitchen-dining, living-dining, study-guest room.

In some instances, it may also be possible to plan an area so that it can change its functions on short notice. For example, a children's play area may be divided at night to form two separate bedrooms, or a portion of the living room may be closed off to form a private guest sleeping room. By such preplanning, the usable area of the house is considerably increased.

The Laundry-Bathroom.—In addition to the standard items that are considered essential in planning a small house, the location of the laundry was carefully studied. Three general choices exist in a basementless, one-story house—laundry equipment may be in the kitchen, it may be in a separate work area, or it may be combined with the other plumbing fixtures in the bathroom. The latter location was chosen for the demonstration houses on the basis of the following considerations:

(*a*) Laundry operations are not compatible with the preparation of food and eating.

(*b*) The home being small in area, it was not desirable to provide a separate utility room to house the water heater, the furnace and the laundry equipment.

(*c*) Water supplies would be available in the bathroom so that few additional plumbing costs would be involved. Also, the walls of the bathroom were to be treated with materials which make them impervious to water or to moisture which is frequently developed in laundering.

(*d*) Most of the articles to be laundered come from the nearby bedrooms, either in the form of bedding or personal linen.

(*e*) The bathroom, of all of the rooms of the house, is the one which is least likely to be upset by laundering during the normal hours for that operation.

Solar Orientation.—The technique of planning for solar orientation is directed at taking fullest advantage of the seasonal positions of the sun to produce comfortable living conditions. In the Champaign-Urbana area of central Illinois, as in most regions of the country where winter comfort is of great importance, this objective presents a double problem: (1) to channel as much sun heat as possible into the house in winter; (2) to exclude sun heat in summer. Large glass areas that admit sun heat during winter periods are a valuable aid in heating the house. But roof overhangs, baffles or other means of control of sunlight are required for summer periods. This double problem has an extensive effect on the position, interior arrangements, and appearance of the house.

In regions where refuge from the cold is more important than summer heat, the first factor which must be taken into consideration is the lot on which the house is placed. Whichever direction the lot faces, the main living areas should, insofar as possible, be opened up to the south. In cases of a lot on the north side of the street, this imposes additional problems of economical means of access and privacy. These are usually solved by placing access routes to one side of the lot and screening the large glass areas on the front with fences or hedges.

Since it is desirable to have as many rooms as possible facing south, the interior arrangements of the house must be carefully studied. The characteristic shape of a "solar" house is a long, narrow rectangle, one room deep, with one long side of the rectangle opening to the south. This shape is often difficult to achieve on a standard city lot; therefore, some compromises usually must be made in the interests of economy. In a more compact, two-room-deep plan, the larger living areas should open to the south, and utility spaces should be concentrated on the north. Bedrooms, if it is not possible to place them on the south, may face either east or west. A western orientation lets in more sun heat in summer than an eastern exposure but, at the same time, in many areas of the country lets in the prevailing summer breezes.

The appearance of the house is also affected by orientation. Wide overhanging eaves, which are not usually seen in traditional architectural styles, become mandatory in conjunction with large glass areas because of the need for summer sun control. Overhangs on the south side prevent the high summer sun from penetrating into the house and, at the same time, permit the low-swinging winter sun to enter. Shed roofs are sometimes used to increase the penetration of the winter sun. The openness of the south side is complemented by closed walls on the east and west where the rays of the horizon-line sun cannot be controlled by overhanging eaves. The final appearance of a house designed for solar orientation is in strong contrast to a conventionally designed house with narrow eaves and evenly spaced windows on all sides.

Solar orientation makes a contribution to the economy of a house mainly in terms of fuel savings.

Sun heat gathered during the day may be retained at night by means of draw draperies. This supplement to the mechanical heating plant often effects considerable savings over a period of a few years. There is additional economy in the fact that most of the glass areas are fixed, with only enough operating sash to insure adequate ventilation.

STANDARDS FOR LIVABILITY.—*Circulation.*—Circulation paths may be considered a barometer of the planning quality of a house. More than any other single factor, these paths affect the usefulness of a whole plan. A "circulation path" may be a closed-in space devoted wholly to circulation, such as a hallway or staircase, or it may be an imaginary "traffic lane" through an open part of a room. If it takes up too much space or is poorly arranged, it may indicate that the whole house plan is carelessly thought out or wasteful. Excessive circulation in a large house is not overly important since isolation of the various parts of the house may be a major objective and the extra space can be easily afforded. However, in small houses, floor area is at a premium and circulation space becomes crucial. In an analysis of numerous house plans,[1] it was found that when the circulation path area exceeded 15 percent of the total floor area of the house, the whole house plan suffered. Rooms became too small or were inefficiently used, and the parts of the house were poorly related to each other.

In a small house the main circulation paths should be (a) centrally located and should (b) radiate to the various parts of the house. They should be direct and as short as possible. It is desirable that from the main entrance one may be able to go to any room in the house without passing through another room. While it is not always possible to achieve this, schemes should definitely be avoided in which the whole length or width of the living room must be crossed in order to reach any other part of the house. Direct communication should be possible between kitchen and dining area, kitchen and bath, kitchen and front entrance. Hallways and staircases which serve no purpose other than circulation should be compact.

Although a traffic lane is an imaginary path whose area can also be used for general activity space, it should be thought of as a well-defined corridor and should be planned carefully. Traffic lanes through rooms should be located so that they cause the least interference with the use of the room. Otherwise, they may make the room into little more than a glorified hallway and make furniture arrangement difficult. In general, a traffic lane should pass close to one wall, thus leaving the main area of the room untouched. If it must pass through the center of a room or area, it should be so located that it divides two different activity areas (for example, conversation and dining).

Doors are an important part of the circulation pattern of the house. Every door implies a circulation path leading to it. Having too many doors may waste essential space. Doors should be studied to determine first, whether or not they are necessary and, secondly, whether they are located so as to provide the most direct and economical access. Door swings should be calculated so as not to waste wall space and not to conflict with other doors.

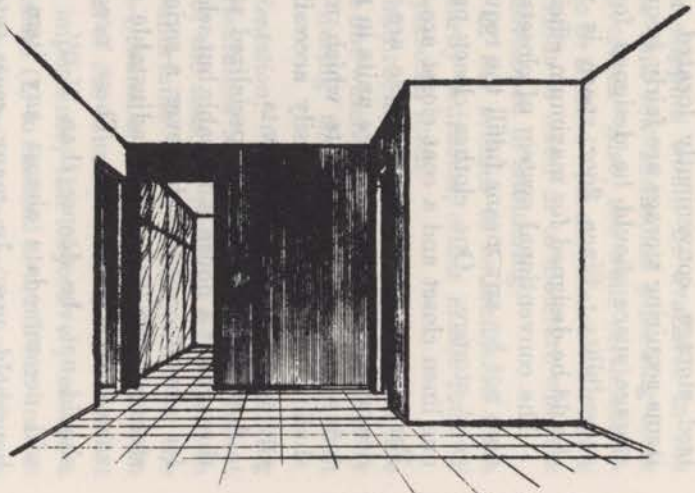
Storage.—Storage space is closely related to household activities and is one of the most critical problems of the small house. Since many homes being built today are without either attic or basement, two major storage areas have been eliminated. This places an added burden on the capacity of the house itself. There is a need not only for more storage space, but for better organized storage, conveniently located. Since most items requiring storage are fairly frequently used, storage space should be designed for maximum accessibility. Since floor space is valuable, it should be designed for maximum efficiency.

The conventional system of closets in a house does not by any means fulfill the requirements of good storage. One clothes closet per bedroom, one linen closet and a coat closet are not enough. For the most part, even these are inefficiently designed. The best storage units in most houses today are kitchen cabinets which make use of shallow upper shelves, easily accessible drawers and specialized compartments.

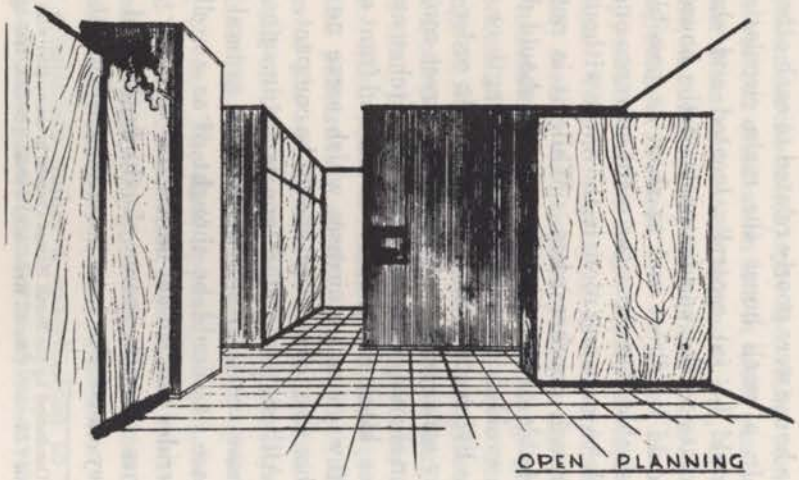
A complete system of specialized storage units throughout a house is desirable but seldom feasible for economic reasons; however, a series of general storage units fitted with adjustable shelves will answer nearly as well. These need not, and should not, be deeper than 2′–0″. This depth will accommodate almost any item in general household use. In many cases, storage units should be shallower than this. For bulky items, such as trunks and baby carriages, a deeper space in a garage or a small storage room can be pro-

[1] Conducted by the Small Homes Council in connection with the Lumber Dealers Research Council Residential Planning Project, 1949–50.

INFLUENCE OF OPEN PLANNING TECHNIQUE
ON INTERIOR SPATIAL EFFECTS
(VIEW OF ENTRANCE - DEMONSTRATION HOUSE)



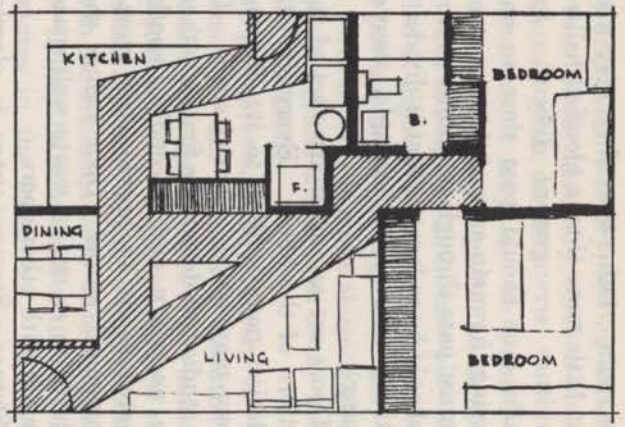
CONVENTIONAL PLANNING



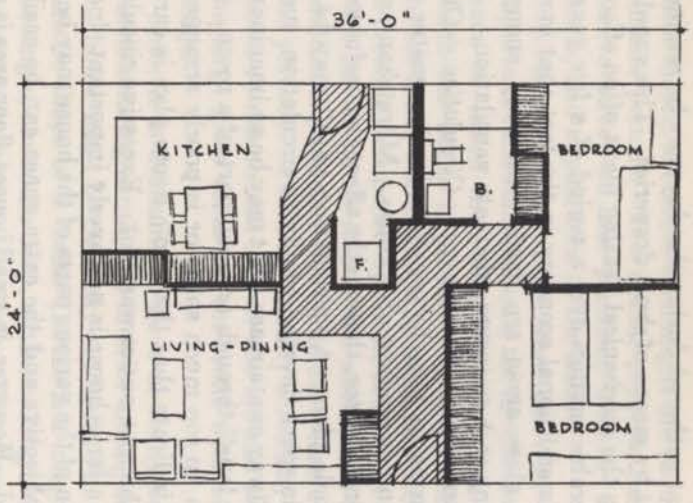
OPEN PLANNING

FIGURE 63.

INFLUENCE OF DOOR LOCATIONS
ON CIRCULATION PATTERNS



CIRCULATION PATH AREA = 20.5 % OF FLOOR AREA



CIRCULATION PATH AREA = 14.4 % OF FLOOR AREA

FIGURE 64.

vided. In addition to general storage, a clothes closet 2′–0″ deep and 4′–0″ wide should be provided for each person occupying a bedroom. For kitchen storage, a general standard of 8′–6″ of wall cabinets and 11′–0″ of base cabinets should be applied.

To be efficient, storage space should be directly accessible for the whole width and height. A conventional closet wastes much space by providing narrow doors and an overhead shelf which is set higher than the top of the door. In order to get at the shelf, a wide clearance must be allowed in front of the shelf which makes the closet excessively deep. The proper design of a closet should include separate doors for high shelves, or else a door which opens the full height of the closet.

Storage space should be relatively unobtrusive—that is, it should not take up wall space which is needed for furniture or windows. A hallway lined with closets or other storage units can take care of a tremendous number of items without interfering with any activity space. Wherever possible, storage units should be part of a wall.

Furniture.—No house should be designed without a consideration of furniture clearances and possible arrangements since these basically affect the size and shape of a room and the location of doors and windows. It is sometimes possible to reduce the actual dimensions of a room if a careful study of possible furniture placement is made. This usually determines which parts of the room should be avoided when planning traffic patterns, and which walls can be made available for doors or window areas.

In a living room the basic unit is the conversation group, consisting of a sofa, chairs and coffee table or end tables, so arranged as to permit several seated persons to see and talk to each other comfortably. In a large room there may also be smaller groupings, or a desk or piano. In arranging conversation groups, a distance of eight feet should be allowed between persons seated facing one another. This may be interpreted as an overall distance, from back to back of furniture, of ten feet. This recommendation need not be adhered to rigidly but should be kept in mind as a general limitation on the arrangement and usefulness of a room. Usually, some living room furniture is backed against a wall. Every living area should contain at least one continuous stretch of wall about eight or nine feet long, uninterrupted by doors or windows (except high, transom-type windows which do not conflict with furniture). This permits the placement of a sofa and at least one end-table, and serves as a nucleus around which to arrange a conversation group.

In a dining area, a 3′–4″ wide traffic lane should be allowed for serving. If the table is in an alcove or corner, so that a full traffic lane is not needed on all sides, a minimum clearance of 2′–6″ should be allowed between the table and wall for comfortable use of dining chairs.

In a bedroom, the minimum clearance at the sides and end of the bed should be 2′–0″. In a single bedroom where the bed is pushed against one wall, there should be a clear area at least 4′–0″ wide for moving about and dressing. A 3′–0″ clearance should be observed between a bed and the face of a dresser to allow for pulling out drawers. If a desk is included in the room, a minimum of 3′–6″ should be allowed between the edge of the desk and the bed to allow easy access to the chair. This also permits passage behind when the desk is being used.

The placement of windows in relation to furniture is particularly important in bedrooms, where it is desirable to have cross-ventilation, but undesirable to have beds directly in the paths of drafts. The use of high, transom-type windows on one wall makes furniture placement easier and insures satisfactory cross-ventilation.

Organized Planning Systems.—In the design of a small house, planning factors can never be divorced from structural considerations. Principles of planning and space use do not produce economy until they are translated into concrete terms of room sizes, material quantities and labor time. In an effort to achieve a working relationship between planning and structure and to reduce the number of variable factors within the design process, organized systems of planning have been developed which are aimed at producing houses that are both livable and economical.

Modular Design.—The most important single tool of structural economy is modular design which seeks to secure efficiency and economy while maintaining flexibility of design. Modular design refers to the sizing of a building, or parts of a building, in relation to a standard three-dimensional unit, 4″ by 4″ by 4″, called a "basic module." [2] This permits the use of stock-size

[2] The principles of modular coordination are discussed in detail in the American Standards Association's A–62 *Guide for Modular Coordination.*

lumber and sheet materials without wasteful cutting and fitting on the job.

Planning modules in multiples of 4″ can be used throughout a building to establish the spacing of walls, columns, studs and joists. These planning modules generally range in size from 16″ on up. Sixteen inches is a convenient and frequently used module for frame construction since it corresponds with normal stud spacing. Four feet is another common planning module since it is a multiple of 16″ and also corresponds to stock sizes of sheet materials.

If a house, or any building, is planned from the beginning on a modular basis, a certain amount of discipline is imposed on the design: A gridwork is set up according to the size of the planning module and is used as a design guide. The repetition of modular units gives the house a structural regularity and affects the plan to some extent. An effort is made to contain the design within the grid lines so that no module is incomplete. If there is not enough space at some point to provide certain features, the building is increased, not the few inches which are absolutely necessary, but enough to include another full module. The cost of this extra space is counteracted by the fact that it can be built economically without extra cutting and fitting of materials. An effort is also made to keep the outline of the building regular since this adds to economy. If an irregularity is necessary, it should begin and end on a grid line. To the extent to which the regularity of the modular units is kept intact, economy of construction is increased.

Unit Planning.—Unit planning is a logical outgrowth of the need for simplifying the processes of designing and constructing houses. The chief advantage of unit planning is that it combines flexibility of arrangement with the economy of standardized parts.

Some space requirements of a house remain constant: The activities of sleeping, cooking, eating, and bathing, for example, are carried on in all houses, and vary relatively little in procedure. Through experience and research it is possible to develop standards for the minimum spaces and equipment necessary. Beds, for example, conform widely to standard sizes, and it is possible to recommend a minimum amount of space to accommodate a bed and clearances around it for access and making it.

Not all activities can be so standardized, and even though the physical space requirements for some activities are uniform, the way in which they are combined with other activities affects the overall amount of space needed. For example, if dining space and kitchen are provided separately, the total space required is more than if they are combined into one area since, in the latter case, some space is common to both activities. Also, if a group of bedrooms and bath are grouped radially around a small, central hall, they require less area than if they are arranged single-file along a corridor. It is possible, however, taking these variations into account, to design a series of stnadardized parts of houses, or units, which can be combined to form a complete house. The units can be combined in numerous ways according to individual requirements.

A system of unit planning has been developed by the Small Homes Council in connection with a project on residential planning.[3] The main units are of three types, providing for the principal activity areas of the house. These are the living-area units, the work-area units, and the sleeping-area units. These three types of units are all that are necessary to make up a complete basic house plan. They divide the house into well-defined areas according to the main activity and make possible a wide variety of plans. They provide a living-dining area, kitchen, laundry, utility space, bedrooms and bath. The units may be fitted together in any number of ways to produce a good house plan to meet different conditions of placement on a site.

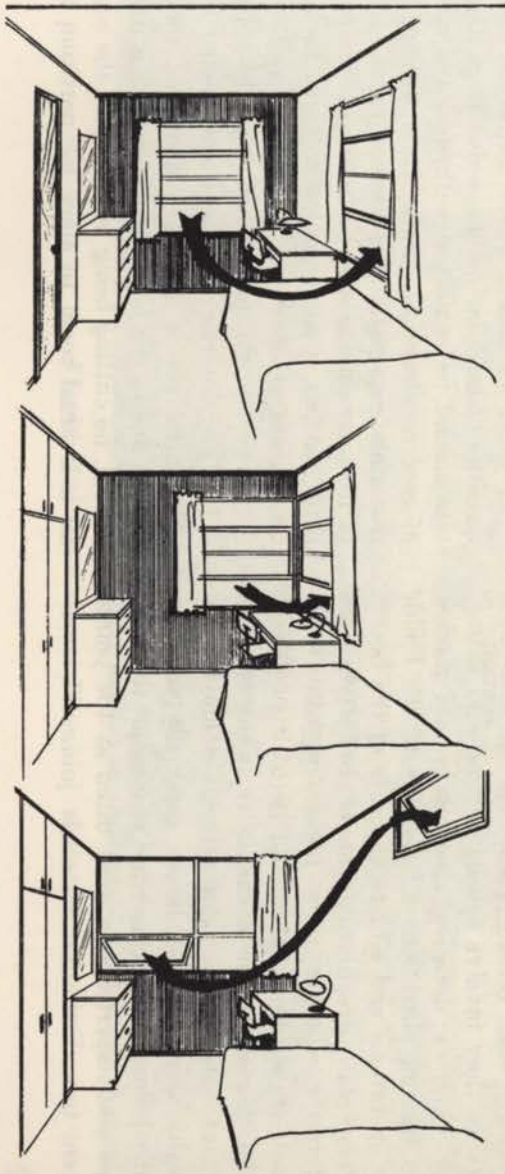
In addition to the basic units, a series of optional units were designed to provide a garage or carport; extra rooms, such as a study or porch; and additional bedrooms in case of expansion of the house.

Most of the units were designed for a one-story, basementless house; however, alternate schemes for work-area units were provided to include a basement stairway. There was a great variety of sizes and shapes among the units. All types of units were graded in size to provide either a minimum house or larger, more spacious house. Many were irregular in shape to provide easier connections with other units.

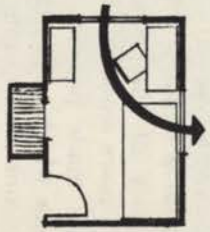
Modular design has an important part in unit planning in that dimensions are standardized and the connections between units simplified. The design of each unit on a 4-foot module allows for

[3] Sponsored by the Lumber Dealers Research Council, 1949-50.

WINDOW PLACEMENT
IN RELATION TO FURNITURE

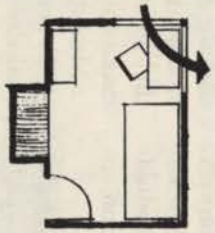


1. CONVENTIONAL



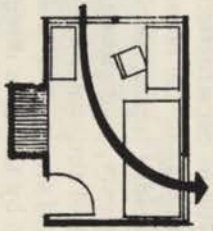
INADEQUATE CROSS-VENTILATION. DRAFT ACROSS BED. POOR LIGHT FOR MIRROR AND DESK.

2. CORNER WINDOWS



INADEQUATE CROSS-VENTILATION. POOR LIGHT AT MIRROR. POSSIBILITY OF GLARE LIGHT AT DESK.

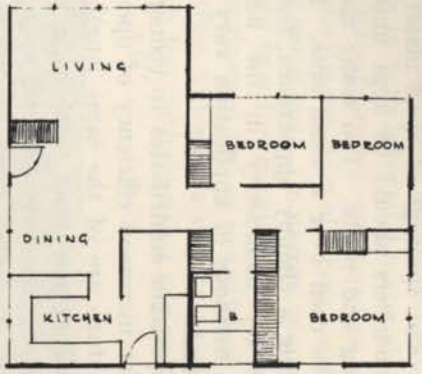
3. TRANSOM WINDOWS



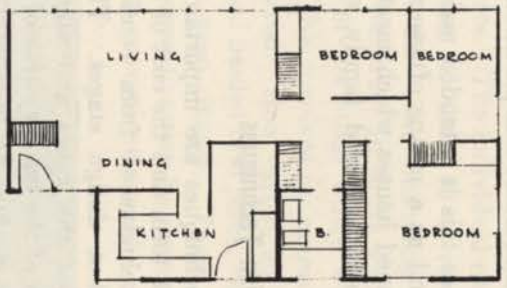
MAXIMUM CROSS-VENTILATION. NO DRAFT ACROSS BED. GOOD LIGHT AT MIRROR AND DESK.

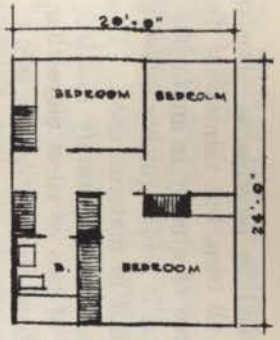
FIGURE 65.

UNIT PLANNING

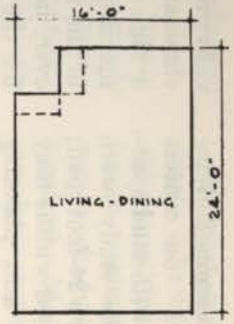


UNITS SHOWN AT RIGHT ARE AMONG THOSE DEVELOPED BY THE SMALL HOMES COUNCIL IN CONNECTION WITH A RESIDENTIAL PLANNING PROJECT (SEE TEXT). THEY CAN BE RE-ARRANGED TO FORM COMPLETELY DIFFERENT HOUSE PLANS.

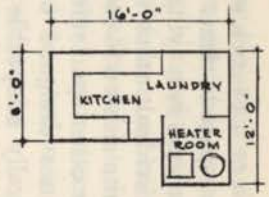




SLEEPING AREA UNIT SB-7



LIVING AREA UNIT LD-8



WORK AREA UNIT W-3

FIGURE 66.

either a 16-inch or a 24-inch stud spacing. Windows may be spaced either 2′–8″ on centers or 4′–0″ on centers, thus tying in with stud spacings. The individual units in the study were planned to fit into either a 16-foot or a 24-foot span; however, many other span referenced widths may be used. Houses designed on a unit planning basis are generally adaptable to clear-span construction and, therefore, should make use of nonbearing partitions and closet-wall partitions whereever possible.

A system such as this is intended mainly as a planning guide, and as a means of assuring economical, well-planned houses which meet a wide variety of site conditions and family space requirements.

III. New Construction Techniques

Construction techniques are important in determining both the form and the cost of a house. They cannot be eliminated from consideration even in the earliest design stages. This is a matter not only of the types and amounts of materials, but also of the basic system of framing members and the method of putting them together. A structural system should not determine a floor plan—it should always be subordinate to the basic design. The dominant factor in choosing a type of construction is its economy in relation to the plan of the house. Once the basic system is decided upon, economy is achieved through simplicity, consistency, and repetition in the execution of the structural details.

Simplicity of structure means merely approaching a solution by the most direct means and weeding out nonessentials. Diagonals and curves, unless they serve a specific purpose which outoutweighs other considerations, should be avoided because they involve special cutting and fitting. Bay windows, dormers, changes in roof pitches and framing directions all complicate the building operations and add to the cost of the house. Every plan irregularity should be studied to determine whether it is necessary, and those which are nonessential should be omitted.

Another approach to simplicity is the elimination of nonessential trim pieces. Some trim is usually necessary in a house, especially at doors and windows, to act as wind stops and to cover gaps and imperfections most often at the points where two dissimilar materials join. Theoretically, it would be possible to save material by eliminating all trim, but this would demand such a high degree of quality in materials and workmanship that it would quickly offset any savings in the amount of material used. There is, however, no need for elaborately molded pieces, nor for the use of two or three pieces for decorative purposes where one will do the job.

Consistency in structure is achieved when plan, framing system and materials work together harmoniously throughout. Materials should be used in a simple, direct manner to avoid extra cost. Sizes and spacings of sheet materials and framing members should be kept uniform to avoid cutting and waste. Too many materials should not be used over a small area. In addition to creating a choppy appearance, frequent changes make for inefficiency in the building process since methods of application vary with different materials.

Repetition contributes to economy by providing for increased efficiency of operations. If all wall studs are of the same length, they can be cut all at one time beforehand and assembled quickly without stopping for special cutting and fitting. If siding is all of one type, it can be applied continuously without waste pieces. If framing members occur at regular intervals, if partitions are all built in the same way, if doors and windows are of the same type—the repetition of operations throughout a building will increase the speed and efficiency of the workmen and make the construction more econominal.

Modular design has made possible improved construction techniques which utilize these three qualities—simplicity, consistency, repetition—to improve efficiency and increase economy during construction.

In order to make fullest use of labor-saving qualities of modular design in dwellings, this system should be combined with a clear-span type of roof construction. Since it is desirable that materials, especially those which come in sheets of modular dimensions, be used with no, or very little, cutting, it is economical to apply them over large areas at one time. The entire ceiling of a one-story, single-span house can be installed before any interior partitions are erected with a substantial saving in time, labor and material. This is due to the fact that the surface is uninterrupted, no cutting being necessary at the edges of an individual room to allow for partition thick-

nesses. The same is true of exterior walls and sometimes the floors.

This method of assembly is known as "open-room construction." The open room is the whole of the enclosed structure. It provides a work-room and material storage space for the interior finishing of the house. This increases the efficiency of the workmen inasmuch as materials are readily accessible and the workspace is not cramped.

Open-room construction is almost inevitably associated with the use of trussed roofs. Light trusses spanning considerable widths permit substantial savings in both labor and materials over conventional joist-and-rafter construction, and make possible the construction of a house without interior bearing partitions. On narrow spans, the "open room" can be achieved with other types of roof, such as single-span flat or low-pitched joist roofs, but the truss will span a variety of widths up to thirty-two feet without using any member larger than a 2″ x 6″.

A logical extension of the advantages of modular design into the construction process is the precutting and preassembling of parts of a house. To insure maximum usefulness of each piece, an accurate scheduling of all materials for precutting is required. More rapid and accurate fitting of members and speed in erection is made possible by preassembly of subparts.

Many operations in building a house are usually performed under awkward or uncomfortable circumstances. The individual cutting of studs and the placing of them in a vertical position are awkward and time-consuming processes. Some builders construct an entire wall and then cut out portions of the studs where windows and doors occur. This involves an excessive waste of time and material. Roof rafters and joists, if cut one by one and hauled into place, can involve discomfort and even danger. These and many other building operations can be performed more quickly, safely and conveniently on the ground.

FIGURE 67.—*Open-room construction.*

An entire stud wall can be precut and assembled in a horizontal position on the floor, then tipped into place in a fraction of the time required by conventional procedures. Roof trusses can be precut and preassembled on a jig table and tipped into position with a minimum of time and effort. Standardized dimensions and materials insure accurate fitting of parts. These techniques can be utilized to advantage by the small builder who constructs houses individually, as well as by the large-scale builder who engages in mass building.

Sheet materials are manufactured in modular sizes and are well adapted to structures planned on a modular basis. However, the success of this type of application depends to a large extent on the regular occurrence of framing members to provide support and nailing surfaces where needed. The modular design must be carried through the entire structure. Every piece of material must be studied and placed in relation to every other piece. This process is made easier to the extent to which standard, uniform sizes and spacings can be used.

Improved Construction Details.—In addition to new construction techniques which embrace the overall building process, several types of improved construction details have been developed which reduce amounts of material and simplify the assembly process, as well as solve specific structural problems.

Roof Trusses.—One design difficulty connected with roof trusses is the problem of providing adequate overhang. A closed, flat soffit involves the use of considerable material which is structurally unnecessary, and variations in width are difficult to make. If the soffit is formed by the extension of the truss beyond the exterior walls, there is, particularly on spans greater than 24′–0″, a problem of eccentricity in the heel joint of the truss. One solution is to form the overhang by extending the top chord member only. This permits a flexibility of width of overhang which is not found in other designs since the only requirement for variation is an extending or shortening of the top chord member. The underside of the soffit may be closed or left open, and the eccentricity in the heel joint is removed since the connection is made directly over the exterior wall.

Another problem is that of ventilation. This is normally accomplished by means of louvers in the gable end. Stock louver units are usually too small to permit adequate ventilation. An improved method is the building of a triangular louver section which comprises about one-third to one-half of the gable-end area. Another method is to build the entire gable end as a louvered section. This incorporates the ventilation area into the design of the house and avoids the building of a specialized section within the gable end.

Windows.—The most noticeable change in window design is the inclusion of large fixed glass areas combined with a limited amount of ventilating area. This type of installation provides more controlled ventilation and more light at less cost. In an effort to arrive at the most economical way to install fixed glass, it was found possible to eliminate the separate window frame which is required for operating sash. This means that the structural framework of the house is a part of the window construction. In other words, the studs themselves form the jambs and mullions of the window units. This reduces the number of trim pieces and simplifies construction. Sill and frame members are designed to be cut on the job. A detail which is satisfactory from the point of view of economy and weather-tightness is obtained by placing the sill member on the outside of the studs. This permits simplified installation and better flashing. Such a detail also permits greater flexibility in the arrangement of openings.

A further design improvement is the elimination of the window header. On window openings up to 4′–0″ in width, the separate header has been found to be unnecessary. On openings 2′–8″ in width, the regular top plate (two 2 x 4's flat) is sufficient to carry up to three times the normal design load. On wider openings, up to 4′–0″, a 4 x 4 top plate or two 2 x 4's reinforced by a steel channel is sufficient. This type of detail saves on material and eliminates the usual cutting and fitting of short studs around the window header.

Closet Walls.—One of the greatest improvements in construction details has been the development of nonbearing storage partitions or closet walls. Reduction in cost and installation time makes possible the provision of a greater amount of storage space in the house. The nonbearing closet partition is made possible by the use of clear-span roof construction. The thinner wall section saves floor space. Tests at the Small Homes Council [2] developed a laminated panel, one-half inch in thickness of commercially avail-

[2] Under sponsorship of Lumber Dealers Research Council.

able sheet materials, which had the necessary resistance to impact, uniform and concentrated loads to enable it to be used in a studless wall as the back of a non-load-bearing closet wall.

In addition to job-built units, there are several prefabricated units on the market.

Another problem which has not yet been completely solved is that of providing an economical closet front. It is desirable to provide doors, or their equivalent, which make the whole interior of the closet readily accessible. This involves either a full-height opening door or a double set of doors separated for upper and lower shelves. Stock doors, 6′–8″ in height, do not meet this requirement and there is a need for closet doors, either manufactured or job-built, which permit full access at a lower cost than stock doors.

Heating.—A development in heating systems has greatly reduced installation costs and presents a combination of the virtues of both radiant and forced warm-air systems. This is the perimeter forced warm-air heating system. Supply ducts are normally laid in a concrete slab, and air is fed into the rooms of the house through diffusing floor or baseboard registers. No return duct system is necessary; cold air-return grilles and plenum are located just above the furnace. Registers are usually located under windows, and the blanket of warm air against the glass reduces condensation problems. The underfloor ducts help to warm the concrete slab, thus eliminating the complaint of "cold floors." This same system, of course, may be used in houses built over a crawl space. The entire crawl space can be used as a warm-air plenum.

Improved Working Drawings.—New techniques and details of planning and construction contain the possibility of reducing costs without compromising the size or livability of a house. They must, however, be planned into the design from the very beginning in order to be effective. During construction, each operation and detail must be executed in a planned manner, and each piece of material must be used in a specified location. This demands a great deal more care and thoughtfulness on the part of the designer.

It is desirable to anticipate construction problems and possible mistakes and to reduce the number of oral instructions or changes necessary during supervision of the building. This has led to a revised concept of working drawings. In addition to the normal plan, elevations and typical wall section, there should be included a series of drawings recording wallboard layouts, if any, window and door details; closet details and construction, roof construction; foundation construction; heating, plumbing and wiring layouts; and the location of every framing member. In this sort of working drawing system, the floor plan and elevation drawings assume secondary importance, being used mainly as a frame of reference for the more detailed construction drawings.

In addition to the drawings, it is sometimes found helpful to include on the working-drawings sheets a complete set of specifications and assembly instructions. This eliminates the necessity for shuffling between two sets of papers and reduces the chances for discrepancies and misinterpretation. Such a set of specifications and instructions can be made quite concise without impairing clarity.

APPENDIX B

Design of Demonstration Houses

I. Description of Plan of Demonstration House

THE PLAN.—The final scheme of the demonstration house consists of a rectangular plan, 30′–0″ x 34′–0″, subdivided into a series of activity areas. These are: sleeping area, composed of two double bedrooms and one single bedroom; living area; kitchen-dining area; laundry-bath area; and play area. All areas are closely related, both spatially and functionally.

The living area is connected with both the kitchen-dining area and the play area. The kitchen is concealed from the living area only by a baffle partition, and the play area is separated by a storage partition which stops short of the ceiling. This allows the eye to penetrate beyond the actual confines of the living area and increases the illusion of space.

The play area occupies a central position in the plan and is the pivot of all activity areas. It is easily accessible from all parts of the house and may be used for general activities as well as for children's play.

The kitchen-dining area includes room for a table and five chairs, and adequate storage space for all utensils and dishes as well as a large closet for reserve food supplies, cleaning equipment, and outdoor work or play clothes.

The bedrooms are designed to include adequate closet space plus provision for beds, drawers unit, and desks. One of the double bedrooms is designed for the use of bunk beds in order to save space.

A departure from conventional plans was made in the development of a laundry-bath area. Since most laundry is stored and used in the bedroom-bath area of the house, it seems logical to include washing equipment in this area. Through the inclusion of an electric dryer, it is possible to eliminate a space-consuming indoor drying room.

OPEN PLANNING.—The house is planned to take maximum advantage of the benefits of open planning. There is no clear-cut separation of elements except for the bedrooms and bath where complete privacy is desirable. The living and play areas borrow visual space from each other by means of the 6′–4″ high storage partition which separates them, and from the south-facing window wall which runs continuously past the partition. There is no bedroom corrridor as such, this function being incorporated into the play area; however, all bedrooms and bath are concealed from view of the living room and kitchen.

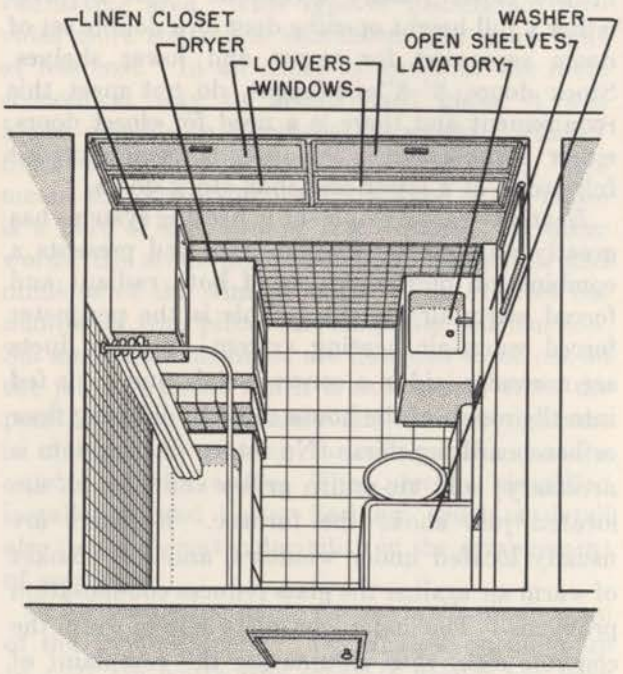


FIGURE 68.—*Laundry-bath.*

MULTIPURPOSE AREAS.—Each area within the house serves more than one function. The living area may be used for quiet conversation or social activities and may, on occasion, be used for dining. The kitchen is used for both cooking and eating. The bath is also used for laundry. The bedrooms may be used for both sleeping and studying.

Of all the areas in the house, the play area is the most versatile. While children are small, it may be used for active play, ironing, or sewing. When the children are grown, the play area is no longer needed, and the separate sections of the storage partition may be rearranged to form a bedroom corridor and a larger living area.

ORIENTATION AND OUTDOOR AREAS.—The house is designed for solar orientation under conditions prevailing in the Champaign-Urbana, Illinois, area. No matter which direction the lot faces, the living and play areas should always face directly south, and the kitchen and bath should be at the north side of the house. The bedrooms may face either east or west. In this way, maximum benefit is derived from the seasonal positions of the sun and prevailing breezes.

The arrangement of outdoor living and service areas depends on the orientation of the site and on individual site conditions.

CIRCULATION.—Circulation within the house is centralized and compact. Major circulation paths comprise 13.8 percent of the total floor area, and both living area and kitchen are free of any through-traffic. Bedroom closets are accessible without traveling around the beds, which leaves a maximum amount of floor area free for furniture and activities.

STORAGE.—Ample storage is provided within the house. Each bedroom allows 4′–0″ of clothes hanging space per person. The kitchen contains 7′–6″ of wall cabinets and 10′–0″ of base cabinets. This is one foot short of recommended standards,[1] but this deficiency is more than made up by the large reserve supply closet. In addition, kitchen storage includes space for cleaning supplies and outdoor work clothes, snowsuits, etc. The laundry-bath area contains storage space for towels and laundry supplies, as well as the conventional medicine cabinet. A large coat closet is provided at the front entrance.

The storage partition between the living and play areas is composed of four separate units, and includes a small desk, bookshelves, and space for card tables, hobby supplies, linens, sewing equipment and materials, sports equipment, toys, and out-of-season clothes.

This interior storage space may be supplemented by space in the garage or carport.

[1] Based on a kitchen planning project conducted by the Small Homes Council, 1947–48. These standards are based on a one-week supply of food.

II. Plan Variations

A series of plan variations for the demonstration house was designed to show its adaptability to the preferences of individual buyers.

In designing the variations, an attempt was made to hold the location of some items constant, such as the furnace plenum chamber and plumbing lines, since these would be built permanently into the slab before the installation of any interior partitions. Otherwise, complete freedom of interior arrangement was possible since there are no bearing partitions. However, as the design work progressed, it was found impractical, for space design purposes, to adhere rigidly to the limitation on heating and plumbing equipment locations. This requirement severely limited the possibilities for room sizes and locations. Therefore, some loosening of this requirement was made, and the variations were based on a total of four utility locations. These changes could be incorporated into the basic house shell at the time of construction at the request of the client.

The seven plan variations shown provide a series of accommodations designed to answer some of the more popular demands of the current market, such as a separate study, separate dining room or alcove, kitchen pass-through, or children's bedrooms which combine into a play space.

Some variation also was made in the relationships between areas. For example, in some cases the dining area is merely an extension of the living area, while in others it is more closely tied to the kitchen area, either as a part of the kitchen itself or as a separate room. When the dining area is treated as a separate room, it is also intended as an indoor play space for children, easily supervised from the kitchen via a door or wide pass-through.

In most of the variations, a laundry-bath arrangement is shown similar to that of the original scheme. However, in a majority of cases, a conventional bathroom can be used and the laundry equipment shifted nearer to the kitchen area if desired. This entails some adjustment in closet space but does not affect the design in any major way. Only in Variation Nos. 4 and 6 is the laundry-bath arrangement mandatory, while in Variation No. 7 a conventional bathroom is required.

Major circulation paths are kept as centralized and compact as possible. In most cases, the circulation path area is 15 percent or less of the total floor area. The most compact circulation occurs

Variation No. 1

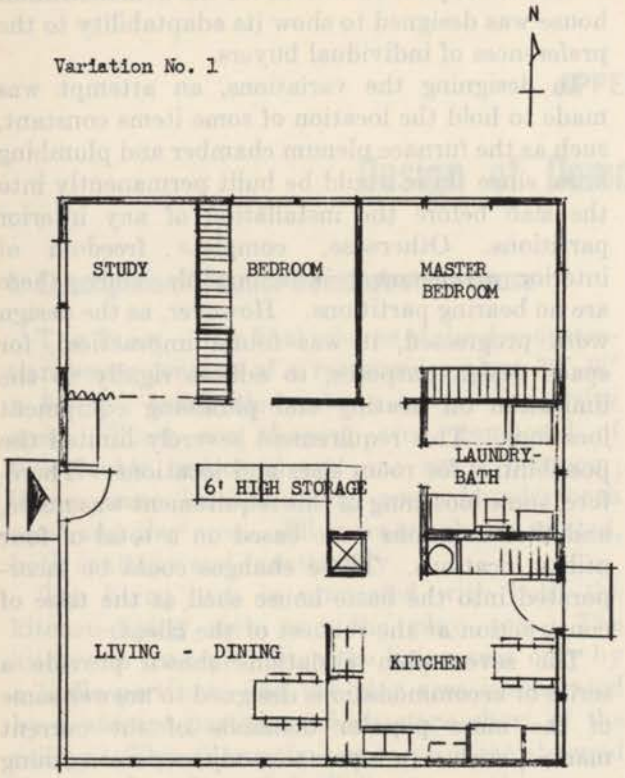


FIGURE 69.

Variation No. 1 is similar to the original pla but provides for two bedrooms and a separat study or hobby room istead of three bedrooms and a play area. The kitchen has been enlarged to provide a more generous dining area and play space for small children, and a more spacious living area is provided. This scheme might be used as a guide if the original plan must be varied in orientation or fenestration. The interior plumbing and heating layouts remain the same as in the original plan, but the circulation area is somewhat increased.

Variation No. 2 (A)

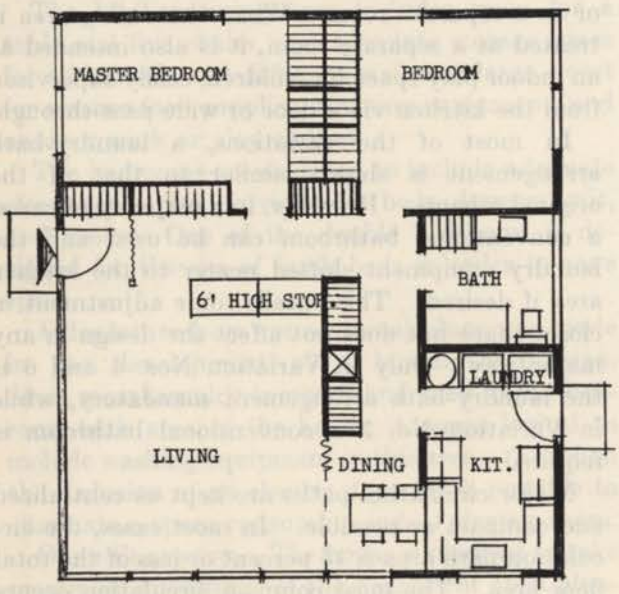


FIGURE 70.

Variation No. 2 may be provided either with two large bedrooms and a dining alcove, or with two smaller bedrooms, a study, and dining room separated from the living area by tall storage cabinets. The kitchen becomes a workspace only, having no provision for eating. Variation 2A provides eating space in a small alcove which may be concealed from the living area by a curtain or folding door, while 2B permits a more formally enclosed dining area.

Variation No. 2 (B)

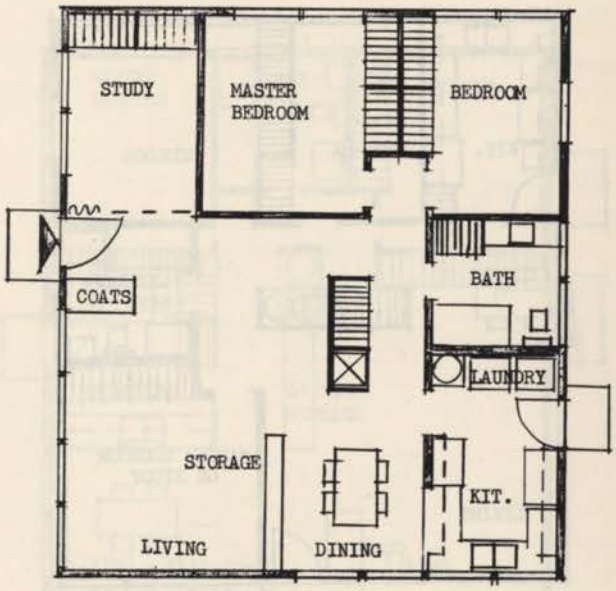


FIGURE 72.

Variation No. 3 provides two large bedrooms and a separate dining-play area. The location of the kitchen has been changed, and a large, open living area has been provided. Laundry equipment could be shifted to the kitchen area by utilizing the closet space adjacent to the rear entrance. Circulation space is compact, and all activity areas are dead-end areas with no through circulation.

Variation No. 3

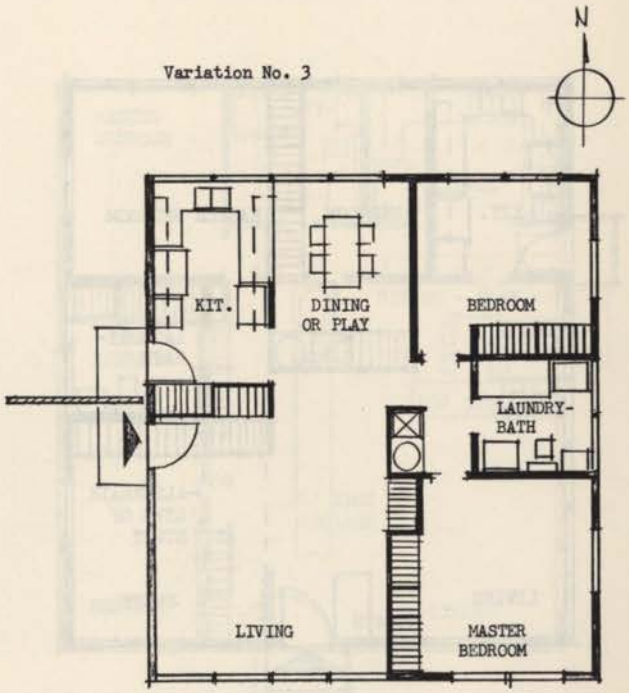


FIGURE 71.

In Variation No. 2B, the closet space indicated in the study is diagrammatic only, and may be subdivided in many ways, depending on the ultimate usage of the room. The heating layout is the same as the original plan, and the basic plumbing layout is the same, although fixture locations are changed. Although both variations are shown with conventional bathrooms and laundry equipment in the kitchen, a laundry-bath arrangement can be easily incorporated, thus allowing more storage space in the kitchen.

Variation No. 4 (A)

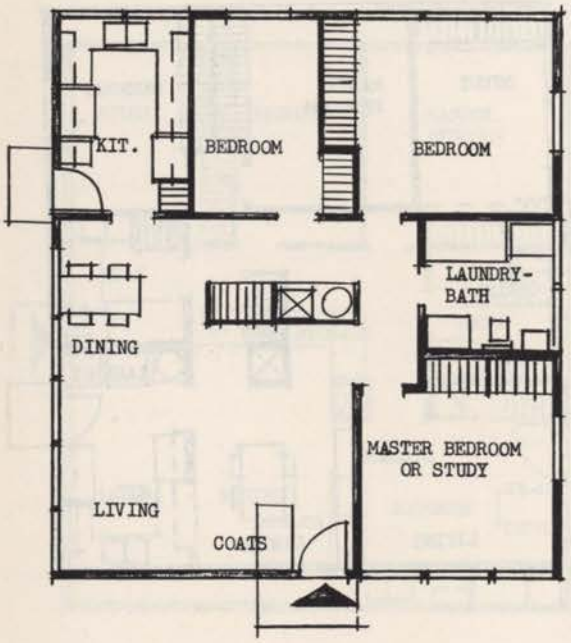


FIGURE 73.

Variation No. 4 is similar to No. 3 in general arrangement. However, this variation may be used either as a three-bedroom house or as a two-bedroom house, with a large study opening to the living area. The furnace and water heater are enclosed in a storage partition which marks off the bedroom hall.

Variation No. 4 (B)

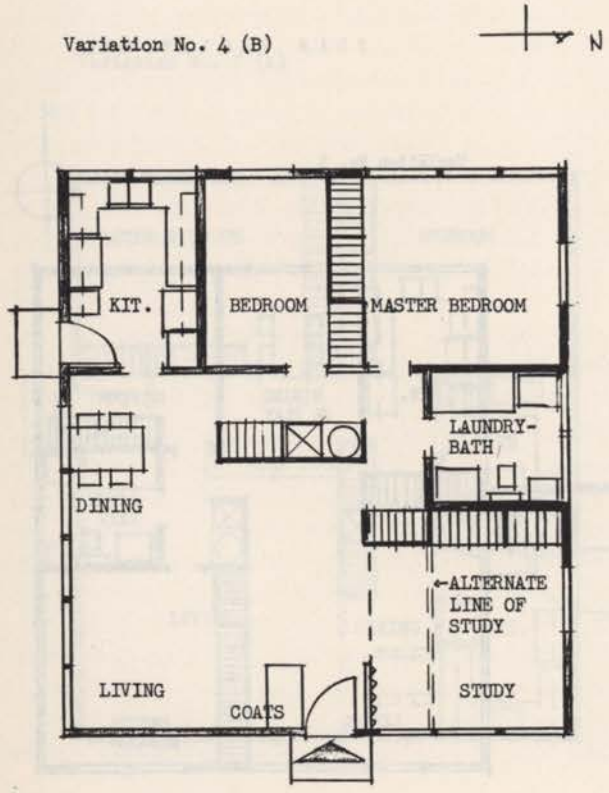


FIGURE 74.

The orientation is the same as that of the original plan. An open dining space is provided at the end of the storage partition, and there is no eating space in the kitchen. The laundry-bath arrangement is essential to the workability of the scheme.

Variation No. 5

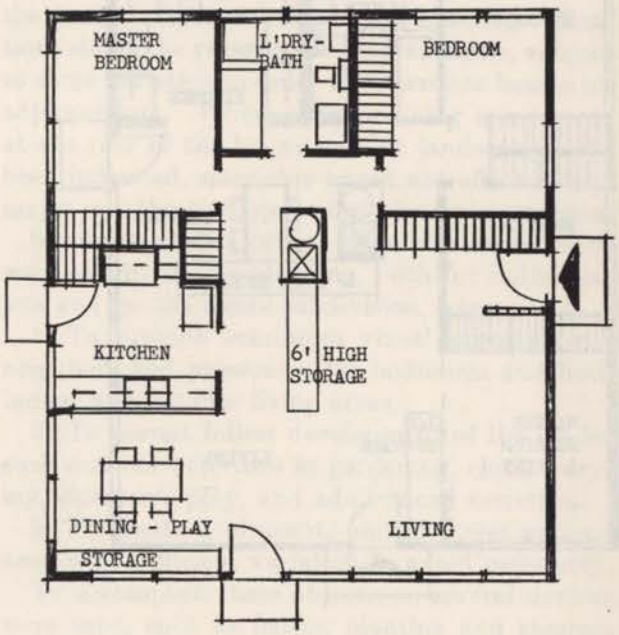


FIGURE 75.

Variation No. 5 is a two-bedroom open plan. The only completely enclosed rooms are the bedrooms and bath. The kitchen opens, by means of a wide pass-through, to a generous dining-play area which, in turn, opens into the large living area. Dining area storage may be either units 6-foot high under transom windows, or desk-height units with counter space for children to draw, write, etc. A free-standing storage partition conceals the kitchen door from the front entrance and living room. Storage space is generous, including a 10-foot length of closet space for coats and living-area storage.

Variation No. 6 (A)

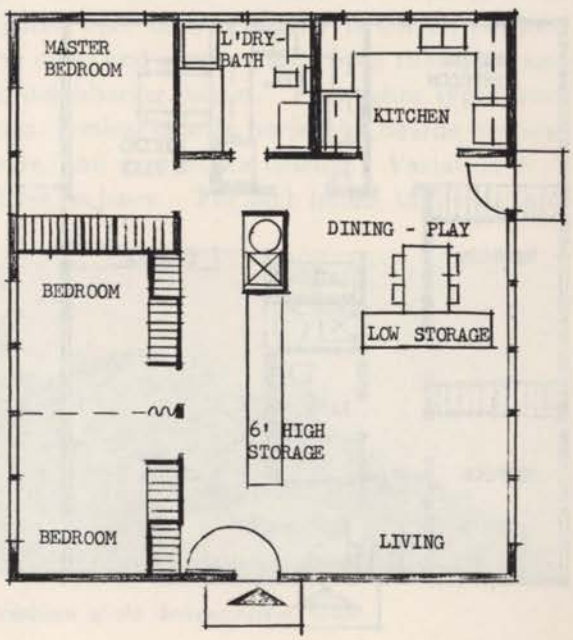


FIGURE 76.

Variation No. 6A places even more emphasis on storage partitions and open planning. The only permanent stud partitions are those enclosing the bathroom and heater room. The remainder of the room demarcations are made by closet-walls, either free-standing or full-height. The two children's bedrooms are actually one general play area which may be separated for sleeping by means of a folding partition. A free-standing storage partition is used to form the bedroom hallway, and another is used to mark off the dining area.

Variation No. 6 (B)

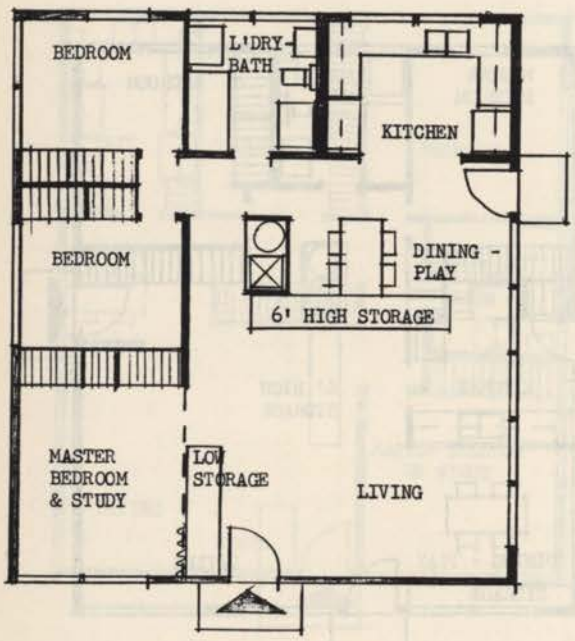


FIGURE 77.

In Variation No. 6B, a different living-dining-kitchen area arrangement is obtained by moving the storage partition. In this case, the bedrooms have also been rearranged. The children's bedrooms are completely separate, and the master bedroom is a semi-open room off the living area, which can also be used as a study. It is conceded that this latter arrangement is not likely to become generally accepted in the near future, but it is included here as a possible type of interior design which should not be completely ignored. If a two-bedroom scheme of this type is desired, the middle bedroom could be enlarged as a master bedroom, and the open master bedroom would become exclusively a study.

Variation No. 7

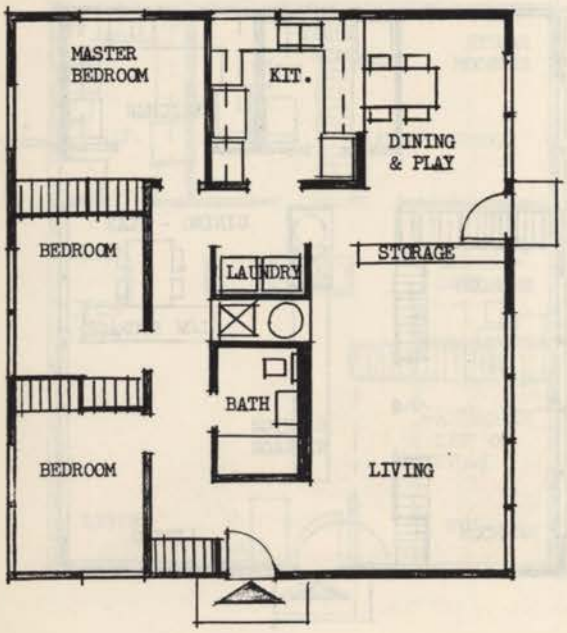


FIGURE 78.

Variation No. 7 is a three-bedroom utility-core plan. All plumbing and heating equipment, with the exception of the kitchen sink, is included in a single central block. The bedrooms are arranged along one side of the plan, and the living and dining areas are on the opposite side, separated from each other by a 1-foot deep storage unit. The dining area is large enough to be used also as a play area, with easy access to outdoor space which can be supervised from the kitchen.

in Variation No. 3 (11.7 percent of total floor area) which compares favorably with the 13.8 percent of the original scheme.

In all variations a generous amount of storage space is provided, in the form both of clothes closets in the bedrooms and of more specialized units elsewhere in the house.

III. Site Planning

In order to demonstrate the applicability of a single house plan to a multiple-house development, a theoretical subdivision of twenty houses was planned for a flat site with a street running east-to-west, using the plan of the demonstration house. This type of site was selected as presenting the most critical problems of orientation and variation of appearance.

A uniform lot size of 70′ by 100′ was chosen to provide adequate frontage and a reasonable depth without exceeding the gross area of a typical 60′ by 120′ subdivision lot. An arbitrary building setback line was set at 20 feet behind the front property line and 5 feet in from the side lines to represent typical building restrictions.

A limited number of possible variations was chosen to provide variety of exterior appearance without any basic changes in the house plan or structural details. These variations included orientation and siting, garage or carport, fences and planting, types of siding, color and roof pitch.

Variations.—A total of six basic variations were planned, two designed for the north side of the street and four for the south side. Each of the variations may be used with either a garage or carport, and most are subject to right or left reversal. In each case, an effort was made to open a major glass area to the south. This area was normally the living-play area, but in some cases the bedroom area was faced south. In no case was it deemed desirable to turn the living-plan area towards the west because of the difficulty of controlling afternoon summer sun. Although shown only on north- or south-facing lots, the variations may easily be adapted to placement on east- or west-facing lots while still maintaining desirable orientation.

On the following pages are shown sketches of the basic variations. Fence and planting indications should be regarded as diagrammatic, subject to some variation in order to interrelate houses on adjacent lots. Where outdoor living areas occur at the rear of the lot no specific landscaping has been indicated, since this would not affect in any major way the development of adjacent properties.

Subdivision Planning.—The objectives which were sought in site planning, both for individual lots and for the entire subdivision, were:

1. To provide maximum visual privacy from neighbors and passers-by for bedrooms and both indoor and outdoor living areas.
2. To permit fullest development of the lot for such outdoor activities as gardening, clothes drying, children's play, and adult social activities.
3. To create a pleasant, unified street appearance with sufficient variation to avoid monotony.

To accomplish these objectives, several devices were used, such as fences, planting and changes in siding materials, color and roof pitch. As mentioned before, no changes were made in shape, size, or interior arrangement. The only change in elevation design was the raising of window-sill heights on the south elevation of Variation N–2.

Fences were used primarily to screen outdoor living areas and service yards from the street and from neighboring houses. Four fence types were chosen: vertical boards, horizontal boards, vertical louvers, and grapestake fencing. Variation N–2 requires no fence. For each house, the fence type

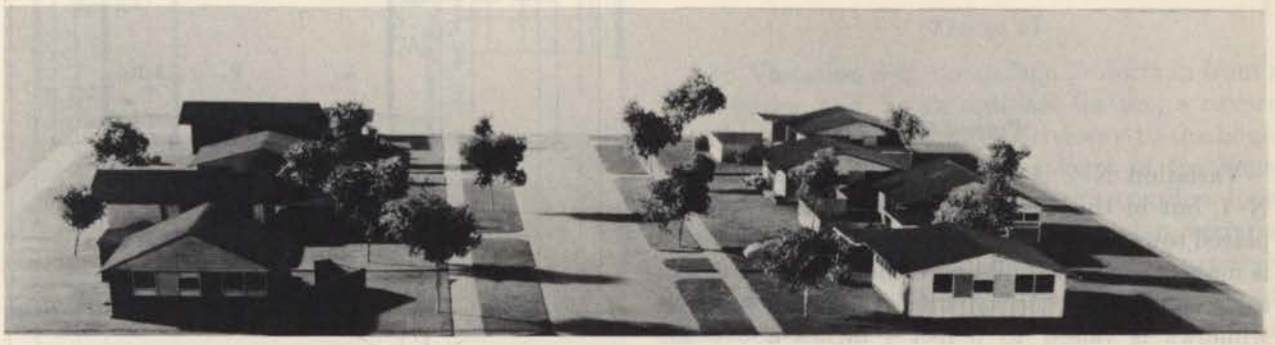


Figure 79.—*Model of the subdivision, using variations of the demonstration house.*

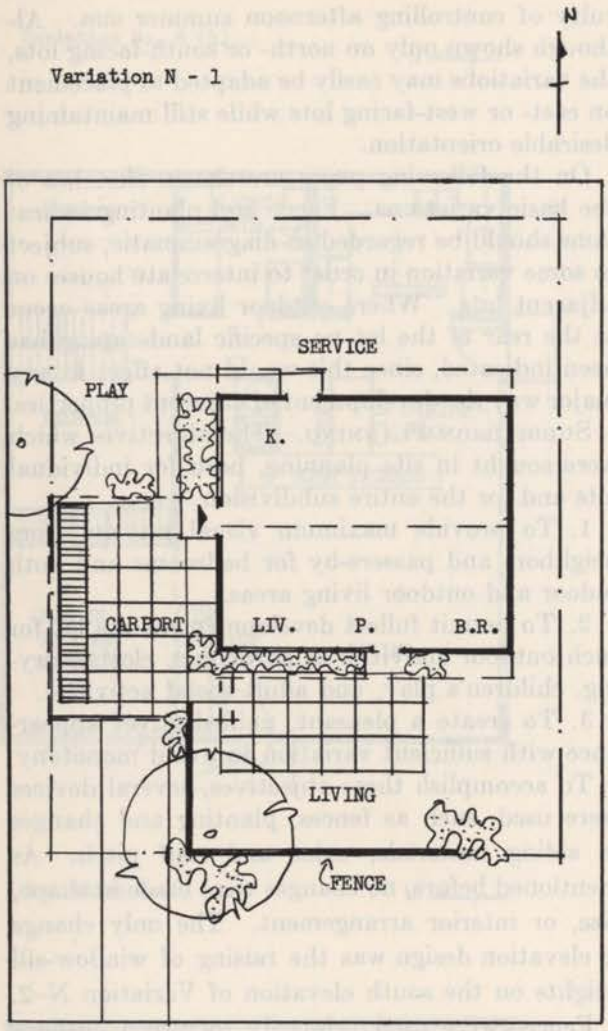


FIGURE 81.

Variation N–2 is oriented in the same way as N–1, but in this scheme the garage or carport is placed towards the rear of the house, and the house is moved up to the building setback line. For the sake of privacy, the sill line of the south-facing windows is raised to 3 feet 4 inches above the floor.

FIGURE 80.

In Variation N–1, for the north side of the street, the living area faces south towards the street. The house is set 20 to 24 feet behind the building setback line to allow for a private outdoor living area which is protected from view by a fence. The main entrance of the house is at the side, and the approach is covered by an extension of the carport or garage roof. The area behind the house is free for development as a children's play area with direct supervision from the kitchen and as a gardening or recreation area. The house is reversible, so that bedrooms may face either east or west.

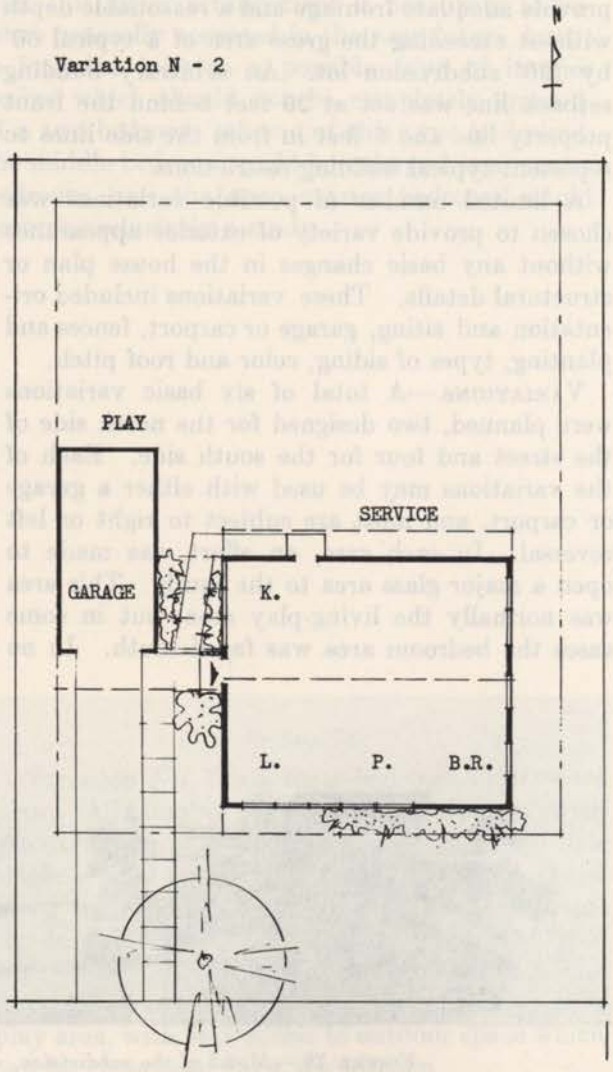
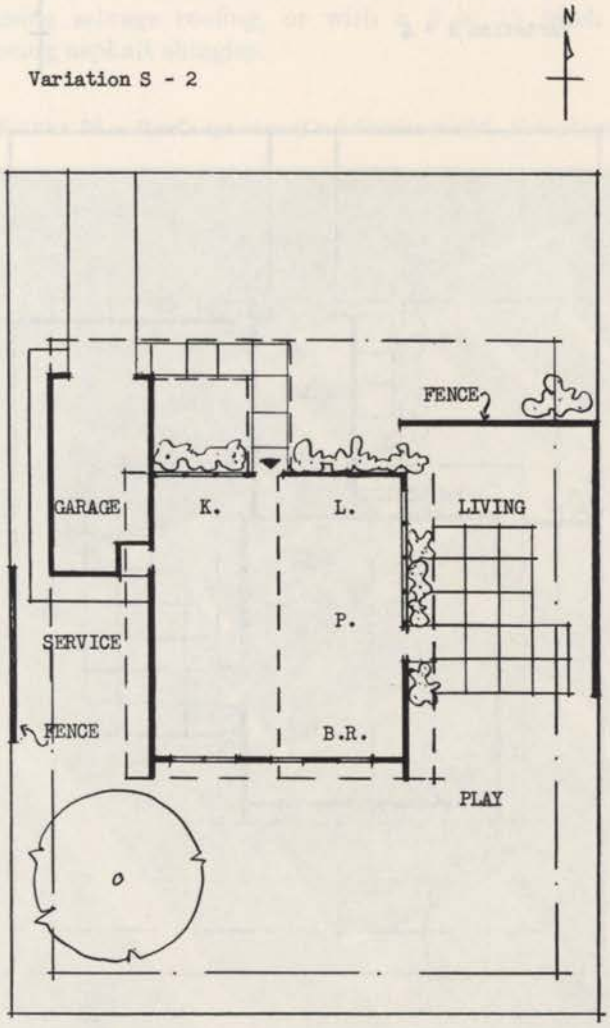


FIGURE 82.

In Variation S–1, designed for the south side of the street, the living-play area faces south to the rear of the lot. The service entrance is located at the front of the lot, easily accessible from the driveway and protected from view by a fence. This requires that the house be located approximately 12 feet behind the building line. The main entrance is at the side of the house and is protected from weather by a deep overhang in front of the garage. The bedrooms may face either east or west.

Variation S - 2



Variation S - 1

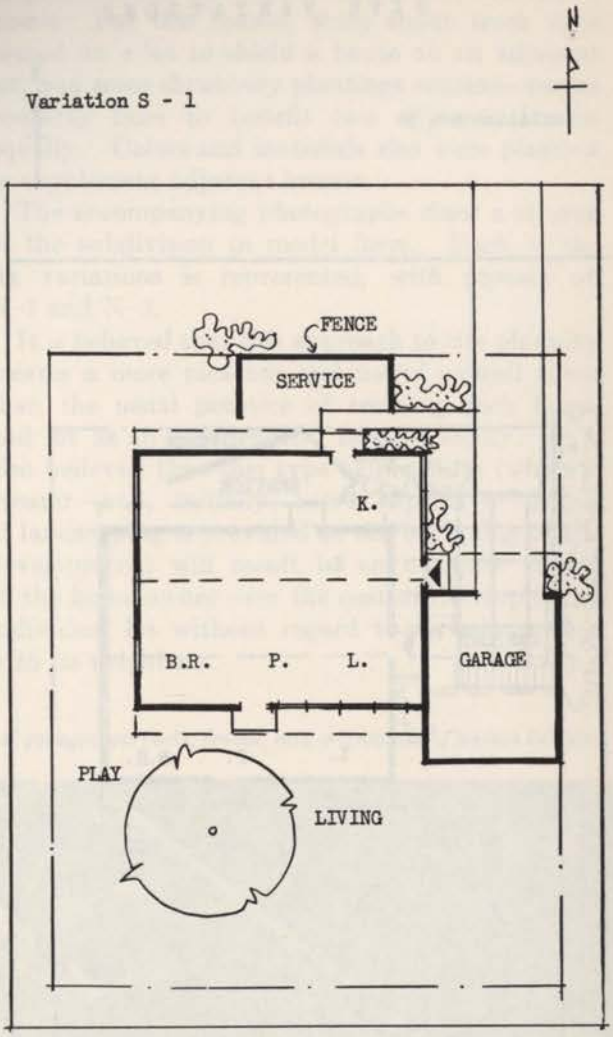


FIGURE 83.

In Variation S–2, the garage projects in front of the house, and, as an optional feature, a covered walk is provided from the driveway to the house. The main entrance is at the front of the house, and the living area faces east, with an outdoor living area at the side of the lot. This plan variation should not be reversed since a western exposure, in conjunction with the large glass areas, would lead to discomfort. Bedroom areas face south to the rear of the lot.

296040 O—54——8

SITE VARIATIONS

Variation S - 3

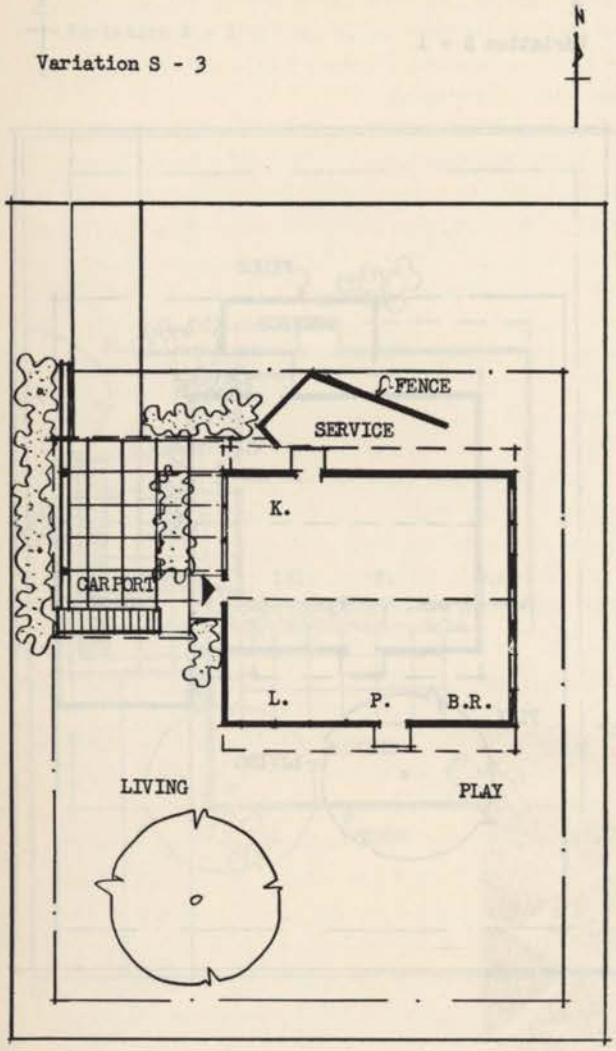


FIGURE 85.

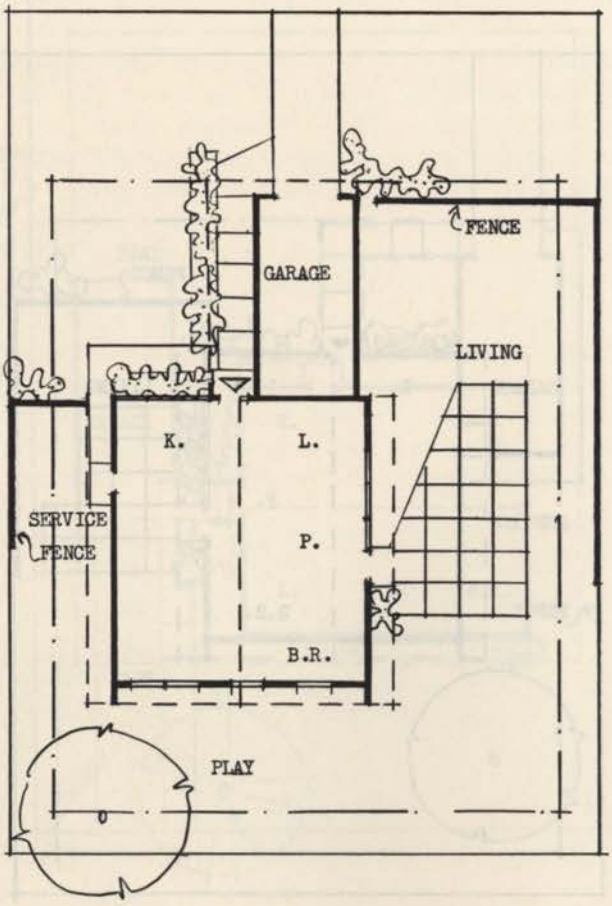
In Variation S–4, the garage or carport is placed in front of the house. The main entrance and kitchen windows face the street, and the living area faces east. A small service yard may be placed at the west side of the house, or the area in front of the kitchen windows may be enclosed to form a children's play yard. The bedrooms face the rear yard to the south.

FIGURE 84.

Variation S–3 has a service yard at the front of the house, and like S–1, is set back from the building line about 12 feet. The garage or carport projects in front of the house, and the roof should be left partially open to provide light and air for the kitchen windows. The living area faces south and the bedrooms face either east or west.

SITE VARIATIONS

Variation S - 4



was selected for its relationship to the lines of the house and the adjacent houses.

Lines of shrubbery were planned to augment the effect of fencing and to continue screening across property lines. Auxiliary plantings of shrubbery and small bushes were used to provide decorative accents. An allowance of one shade tree per lot was made, and these trees were placed mainly for protection from late afternoon summer sun.

Three types of siding were selected: asbestos board and batten, horizontal bevel siding, and vertical siding. Of the 20 houses, 14 used asbestos board and batten: 3 used bevel siding (including one of redwood): and 3, vertical redwood siding.

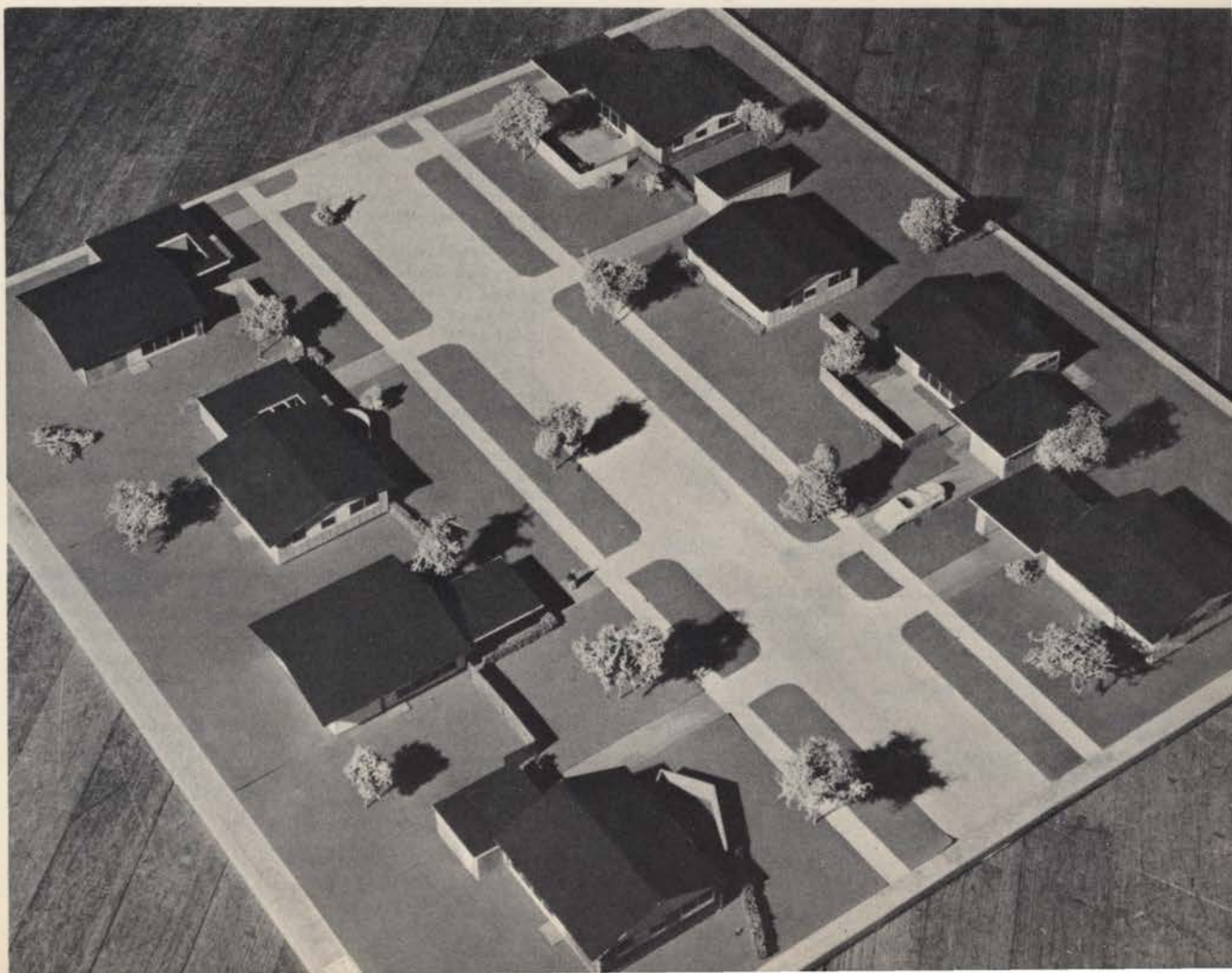
Five colors were used: 6 houses were painted white, 5 gray, 4 redwood, 4 green, and 1 yellow. These were used with various combinations of trim and panel colors. To provide continuity, all roofs were black, either with a 3½ in 12 pitch using selvage roofing, or with a 5 in 12 pitch using asphalt shingles.

In general, emphasis was placed on the relationship between houses rather than on any individual house. For this reason, some shade trees were placed on a lot to shield a house on an adjacent lot, and some shrubbery plantings continue across property lines to benefit two adjacent houses equally. Colors and materials also were planned to supplement adjacent houses.

The accompanying photographs show a section of the subdivision in model form. Each of the six variations is represented, with repeats on N–1 and N–2.

It is believed that this approach to site planning creates a more pleasant and useful overall effect than the usual practice of treating each house and lot as an independent, isolated entity. It is also believed that this type of planning (where a greater—and, initially, more expensive—degree of landscaping is provided at the beginning of the development) will result in an ultimate saving to the home owner over the cost of developing an individual lot without regard to its relationship with its neighbors.

FIGURE 86.—*Bird's-eye view of subdivision model. Note placement of garages, carports, fences, and orientation of houses on lots.*



APPENDIX C

Material List

A material list was prepared as a portion of the drafting-room studies. It serves as a basis for the cutting and ordering schedules which are reproduced in Part V of the appendix. A review of the material list will indicate that the general contractor subcontracted for much of the mechanical work and for certain other activities. He confined his work, in general, to carpentry.

The materials are listed by components—the major parts which make up a house. The list is shown in the following table.

TABLE 3.—*Material list*

Component	*Order schedule*
Component 1.—EARTH PREPARATION	
Component 2.—LAYOUT	
Component 3.—EXCAVATION	
Component 4.—FOUNDATIONS	
A. Forms	
B. Footings:	
1. House—8" x 12"	132 lin. ft.—4 cu. yds.
C. Block—Concrete:	
1. House, 8 x 8 x 16	294.
4 x 8 x 16	98.
Precast caps, 4 x 8 x 16	98.
D. Insulation, 12" x 18" x 1" A. E. perimeter insulation	128 lin. ft.
E. Termite Shield, 1 roll, 10" 3 oz. copper armoured Kraft paper	120 lin. ft.
F. Anchor Bolts, ½ x 12	16.
Component 5.—FLOOR	
A. Heat ducts—Subcontract:	
Boots—4" x 14"	11.
Boots—6" x 8" x 18"—Kitchen	1.
Adjustable elbows	14.
Air ducts—7"	250 lin. ft.
B. Fill, Gravel pit run	15 cu. yds.
C. Vapor barrier, Kraft paper, 1½ roll, 8' width	1,500 sq. ft.
D. Concrete and wire mesh:	
Concrete—1-2-3 mix	15 cu. yds.
Wire mesh—#10—1½ rolls	1,500 sq. ft.
E. Finish floor 9" x 9" x ⅛", "C" grade asphalt tile	1,025 sq. ft.
Component 6.—EXTERIOR WALLS	
A. Framing:	
Wall No. 1:	
21—Studs—2 x 4 x 7'—7⅝"	See Table 4.
1—Stud—2 x 4 x 6'—7½"	

TABLE 3.—*Material list*—Continued

Component	*Order schedule*
Component 6.—EXTERIOR WALLS—Continued	
A. Framing—Continued	
Wall No. 1—Continued	
3—Studs—2 x 4 x 5'—5¾"	
9—Headers 3'—8¾"	
4—T. plates—2 x 4 x 18	
2—B. plates—2 x 4 x 18	
2—Blocking—2 x 4 x 1'—9½"	
1—Stran steel—3 13/16 x 1/16 x 5'—0"	
1—Stran steel—3 13/16 x 1/16 x 9'—0"	
1—Blocking—2 x 4 x 0'—10½"	
2—Blocking—2 x 4 x 0'—7¼"	
Wall No. 2.	
19—2 x 4 x 7'—7⅝"	
4—2 x 4 x 3'—0¾"	
13—2 x 4 x 3'—8¾"	
4—2 x 4 x 1'—9½"	
4—2 x 4 x 16	
2—2 x 4 x 16	
2—Stran steel—3 13/16 x 5'—0"	
1—Stran steel—3 13/16 x 9'—0"	
Wall No. 3	
18—2 x 4 x 7'—7⅝"	
3—2 x 4 x 6'—5⅞"	
1—2 x 4 x 6'—7½"	
15—2 x 4 x 3'—8¾"	
4—2 x 4 x 18'	
2—2 x 4 x 18'	
1—Stran steel—3 13/16 x 1/16 x 17'	
1—Stran steel—3 13/16 x 1/16 x 12'—6"	
Wall No. 4	
17—2 x 4 x 7'—7⅝"	
1—2 x 4 x 3'—0¾"	
1—2 x 4 x 6'—7½"	
12—2 x 4 x 3'—8¾"	
4—2 x 4 x 16'	
2—2 x 4 x 16'	
1—Stran steel—3 13/16 x 1/16 x 12'—6"	
2—Studs 2 x 4 x 4'—2½"	
4—Blocking 2 x 4 x 1'—9½"	
1—Stud—2 x 4 x 2'—1¾"	
B. Sheathing:	
Wall No. 1: 7—4 x 8 x ¾ sheathing	19—4 x 8 x ¾ sheathing.
Wall No. 2: 5—4 x 8 x ¾ sheathing	608 sq. ft.
Wall No. 3: 4—4 x 8 x ¾ sheathing	
Wall No. 4: 2—4 x 8 x ¾ sheathing	
C. Siding:	
Wall No. 1: 7—4 x 8 x 1/6 asbestos cement	19—4 x 8 x 1/6 asbestos cement. 9 pcs. 1 x 8 W. P. 45 bd. ft.
Wall No. 2: 5—4 x 8 x 1/6 asbestos cement	
Wall No. 3: 4—4 x 8 x 1/6 asbestos cement	
Wall No. 4: 2—4 x 8 x 1/6 asbestos cement	
D. Battens: 36—1 x 2 x 7'-11½"	
E. Gable Ends:	
4—2 x 6 x 20'	
4—2 x 6 x 16'	
9—2 x 4 x 12'	
4—1 x 2 x 16'	

TABLE 3.—*Material list*—Continued

Component	*Order schedule*
Component 6.—EXTERIOR WALLS—Continued	
E. Gable Ends—Continued	
4—1⅛ x 1⅝ x 20′	
160 sq. ft. 24″ screen	
24—7/16 x 8 x 16′ bevel siding	
5—1 1/16 x 6 x 16′	
4—2 x 8 x 4′ out of 2 x 8 x 16′	
2—2 x 6 x 3′ 6″	
2—½″ x 4″ bolts	
4—2 x 4 x 16′	
36—2 x 6 x 20′	
36—2 x 6 x 16′	
5—2 x 6 x 14′	
8—1 x 6 x 14′	
32—1 x 6 x 10′	
32—4″ Teco ring connectors	
32—½ x 4 bolts	
9—2 x 4 x 12′	
4—1 x 2 x 16′	
160 sq. ft. 24″ screen	
24—7/16 x 8 x 16′ bevel siding	
5—1 1/16 x 6 x 16′ bevel siding	
1—2 x 8 x 16′	
4—2 x 4 x 16′	
F. Louvers: 16 louvers	
Component 7.—ROOF FRAMING	
A. Trusses:	
32—2 x 6 x 20′	
32—2 x 6 x 16′	
32—1 x 6 x 3′—6½″	
32—1 x 6 x 7′—5″	
32—1 x 6 x 2′	
16—2 x 6 x 3′—6″	
32—4″ Teco ring connectors	
32—2 x 6 x 1′—3½″ waste	
32—½″ x 4″ bolts	
B. Sheathing: 252—1 x 6 x 12	T and G sheathing, 1512 bd. ft.
C. Starter Strips:	
15 lb. felt—3 rolls	1,500 sq. ft.
Roofing 19″ selvage	14 sqs. (28 rolls).
144 lineal feet T-starter strip	
Component 8.—EXTERIOR TRIM	
A. Soffit	36—1 x 6 x 12′ shiplap.
B. Fascia	6—1 x 4 x 12′ WP
C. Rake	4—1 x 4 x 20′ WP
Component 9.—PARTITIONS	
A. Wall No. 1:	
10—Studs—2 x 2 x 7′—8¼″	See Table 4.
2—Plates—2 x 6 x 8′—0″	
2—Blocking—2 x 2 x 1′—10⅜″	
1—Cripple—2 x 2 x 1′—7½″	
B. Wall No. 2:	
5—Studs—2 x 2 x 7′—8¼″	Do.
2—Plates—2 x 2 x 8′—0″	
4—Blocking—1 x 4 x 1′—10⅜″	
4—Blocking—1 x 4 x 1′—9 1/16″	
C. Wall No. 3:	
9—Studs—2 x 4 x 7′—8¼″	Do.
1—T. Plate—2 x 4 x 13′—1⅝″	
2—B. Plate—2 x 4 x 5′—6 1/16″	
1—Door header—2 x 4 x 2′—5⅞″	
1—Cripple—2 x 4 x 0′—9⅛″	
1—Blocking—1 x 4 x 2′—3″	
1—Blocking—1 x 6 x 2′—3″	
2—Blocking 1 x 4 x 1′—10⅜″	
2—Blocking 1 x 4 x 0′—7⅜″	

TABLE 3.—*Material list*—Continued

Component	*Order schedule*
Component 9.—PARTITIONS—Continued	
D. Wall No. 4:	
17—Studs—2 x 4 x 7′—8¼″	See Table 4.
3—Door headers—2 x 4 x 2′—7⅞″	
3—Cripple—2 x 4 x 0′—7⅜″	
1—B. Plate—2 x 4 x 5′—1 3/16″	
1—B. Plate—2 x 4 x 2′—5 5/16″	
1—B. Plate—2 x 4 x 5′—4⅛″	
1—B. Plate—2 x 4 x 0′—9 1/16″	
E. Wall No. 5:	
7—Studs—2 x 2 x 7′—8¼″	Do.
2—Plates—2 x 2 x 11′—11⅞″	
F. Wall No. 6:	
6—Studs—2 x 4 x 7′—8¼″	Do.
2—Plates—2 x 4 x 8′—5⅞″	
2—Blocking—2 x 4 x 1′—10⅜″	
1—Cripple—2 x 4 x 1′—0″	
Component 10.—WINDOWS	
D. Setting Fixed Glass:	
South elevation	4—7/32 x 80 x 46.
	4—DSB x 12 x 46.
West elevation	2—DSB x 28 x 46.
	1—DSB x 12 x 46.
East elevation	3—3/16 x 42 x 46.
	1—DSB x 28 x 46.
North elevation	3—DSB x 12 x 46.
E. Trim:	
Wall No. 1:	
Head:	
16′—0″—1½ x 1⅝	See Table 4.
4′—0″—½ x ¾	
Intermediate:	
12′—0″—Sill	
12′—0″—½ x ¾	
Sill:	
16′—0″—Sill	
16′—0″—½ x ¾	
Mullion:	
6′—0″—1½ x 1⅝	
8′—0″—½ x ¾	
Jamb:	
4′—0″—1½ x 1⅝	
2′—0″—½ x ¾	
Wall No. 2:	
Head:	
24′—0″—1½ x 1⅝	Do.
20′—0″—½ x ¾	
Intermediate:	
20′—0″—½ x ¾	
4′—0″—Sill	
Sill:	
12′—0″—½ x ¾	
12′—0″—Sill	
Mullion:	
8′—0″—1½ x 1⅝	
12′—0″—½ x ¾	
Jamb:	
9′—0″—1½ x 1⅝	
7′—0″—½ x ¾	
Wall No. 3:	
Head:	
28′—0″—1½ x 1⅝	Do.
24′—0″—½ x ¾	
Intermediate: 16′—0″—½ x ¾	
Sill:	
28′—0″—Sill	
16′—0″—1 1⅝	
8′—0″—½ x ¾	
Mullion:	
27′—0″—1½ x 1⅝	
48′—0″—½ x ¾	

TABLE 3.—*Material list*—Continued

Component	*Order schedule*
Component 10.—WINDOWS—Continued	
E. Trim—Continued	
Wall No. 3—Continued	
Jamb:	
17′—0″—1½ x 1⅝	
17′—0″—½ x ¾	
Wall No. 4:	
Head: 12′—0″—1½ x 1⅝	See Table 4.
Intermediate:	
12′—0″—1½ x 1⅝	
12′—0″—Sill	
36′—0″—½ x ¾	
Sill:	
12′—0″—Sill	
12′—0″—½ x ¾	
Mullion:	
8′—0″—1½ x 1⅝	
12′—0″—½ x ¾	
Jamb:	
9′—0″—1½ x 1⅝	
7′—0″—½ x ¾	
Component 11.—WIRING	
Subcontract	
Component 12.—INSULATION	
Ceiling: 4″ x 23″ x 48″	12 ctns=900 sq. ft.
Component 13.—WALLBOARD	
B. Ceiling:	
14—4′ x 12′ x ½″	See Table 4.
2—2′ x 12′ x ½″	
7—4′ x 10′ x ½″	
1—2′ x 10′ x ½″	
C. Side Walls:	
Wall No. 1:	
2—4′ x 12′ x ½″	Do.
1—4′ x 10′—11″ x ½″	
1—4′ x 10′ x ½″	
1—4′ x 8′—3″ x ½″	
1—4′ x 4′ x½″	
Wall No. 2:	
4—4′ x 8′ x ½″	Do.
2—4′ x 3′—3″ x ½″	
1—2′ x 8′ x ½″	
Wall No. 3:	
1—4′ x 9′ x ½″	Do.
1—2′—9⅛″ x 10′ x ½″	
1—2′ x 8′ x ½″	
1—4′ x 4′ x ½″	
1—2′—9⅛″ x 3′ x ½″	
1—1′—3⅜″ x 4′ x ½″	
Wall No. 4:	
1—4′ x 10′—2″ x ½″	Do.
1—4′ x 10′ x ½″	
2—4′ x 4′ x ½″	
2—4′ x 4′—3″ x ½″	
1—4′ x 8′ x ½″	
D. Partitions:	
Wall No. 1: 4—4′ x 8′ x ½″	Do.
Wall No. 2: 4—4′ x 8′ x ½″	Do.
Wall No. 3:	
4—4′ 8′ x ½″	Do.
4—2′ x 4′ x 8′ x ½″	
2—0′—6″ x 8′ x ½″	
Wall No. 4:	
1—4′ x 12′ x ½″	Do.
1—4′ x 8′ x ½″	
1—4′ x 5′—4″ x ½″	
1—4′ x 5′—2″ x ½″	
1—4′ x 2′—6″ x ½″	

TABLE 3.—*Material list*—Continued

Component	*Order schedule*
D. Partitions—Continued	
Wall No. 4—Continued	
1—4′ x 1′—10″ x ½″	
1—4′ x 0′—10″ x ½″	
Wall No. 5: 4—4′ x 12′ x ½″	See Table 4.
Wall No. 6: 4—4′ x 8′—5⅞″ x ½″	Do.
E. Taping.	
Component 14.—DOORS	
1—Combination	3′—0″ x 6′—8″.
2—Combination	2′—8″ x 6′—8″.
1—Exterior doors	3′—0″ x 6′—8″ x 1¾.
2—Exterior doors	2′—8″ x 6′—8″ x 1¾.
3—Interior doors	2′—6″ x 6′—8″ x 1⅜.
1—Interior door	2′—4″ x 6′—8″ x 1⅜.
A. Jamb and headers:	
4—1 x 4 x 14′—0″ WP	
1—1 x 4 x 12′—0″ WP	
3—¾ x 4 x 14′—0″ WP	
1—¾ x 4 x 12′—0″ WP	
C. Butts:	
4½—pair—4″ x 4″	
6—pair—3½ x 3½	
D. Locksets:	
3—exterior—415 PD key locks	
1—privacy—A405 privacy locks	
3 bedrooms—A405 privacy locks	
E. Door stops: 7—door stops:	
Component 15.—SEPTIC TANKS	
Subcontract	
Component 16.—KITCHEN CABINETS	
Component 17.—CLOSET WALL UNITS.	See Table 4.
Component 18.—PAINTING	
All painting, subcontract.	
Component 19.—FLUE	
1 Prefabricated flue	
Component 20.—PLUMBING	
Subcontract	
Component 21.—HEATING	
Subcontract	
Component 22.—GARAGES	
A. Footing—8 x 16″-70 lin. ft	2 cu. yds.
B. Block—Concrete	224—8 x 8 x 16.
	51—4 x 8 x 16.
C. Floor:	
Concrete 1-3-5 mix	6 cu. yds.
Wire mesh #10	288 sq. ft.
D. Walls:	
No. 1:	
Top plates:	
1—24′-8″	
1—24′-0″	
Bottom plates: 1—24′-8″	
Studs 12—6′-6⅜″	
Door bucks: 2—6′-10½″	
Headers: 1—3′-8¾″	

TABLE 3.—*Material list*—Continued

Component	*Other schedule*
Component 22.—GARAGES—Continued	
D. Walls—Continued	
No. 2:	
Top Plates:	
1—24′-8″	
1—24′-0″	
Bottom plates: 1—24′-8″	
Studs:	
13—6′-6⅜″	
3—5′-6¼″	
Headers: 3—3′-8¾″	
No. 3:	
Top plates:	
1—12′-8″	
1—12′-0″	
Bottom plates: 1—12′-0″	
Studs: 7—6′-6⅜″	
No. 4:	
Top plates:	
1—12′-8″	
1—12′-0″	
Bottom plates: 1—12′-0″	
Studs 6—6′-6⅜″	
Headers: 6—3′-8¾″	
Sheathing:	
Wall No. 1: 5—¾″ x 4 x 8	14—4 x 8 x ¾.
Wall No. 2: 6—¾″ x 4 x 8	
Wall No. 3: 3—¾″ x 4 x 8	
Siding:	
Wall No. 1: 5—4 x 8 x ⅛″, asbestos ce-	14—4 x 8 x ⅛″ asb. cement.
Wall No. 2: 6—4 x 8 x ⅛″, asbestos ce-ment.	
Wall No. 3: 3—4 x 8 x ⅛″, asbestos ce ment.	
25—1 x 2 x 7′-7⅝″, battens	
Doors:	
1—3′0″ x 6′8″ panel door	
1—½ prime butts	
1 lock set	
E. Roof:	
12—2 x 8 x 16′—0″ joists	See Table 4.
14—2 x 8 x 12′—0″ joists	
2—2 x 8 x 8′—0″ beam	
1—2 x 8 x 6′—0″ outlooker	
5—2 x 8 x 3′—9″ outlooker	
1—4 x 4 x 10′—0″ post	
4—2 x 8 x 1′—9″	
Sheathing:	
110—1 x 6 x 14 yellow pine T and G	Do.
13 Rolls 19″ selvage roofing—6½ squares.	
2 Rolls 15# felt—650 sq. ft.	
84—lin. ft.—T—starter strip	
Garage soffit, 68—1 x 6 x 14 Shiplap	
Fascia:	
1—1 x 10 x 8′—0″	
4—1 x 10 x 14′—0″	
2—1 x 10 x 12′—0″	

TABLE 3.—*Material list*—Continued

Component	*Other schedule*
Component 22.—GARAGES—Continued	
F. Window trim:	
North wall:	
Head:	
12′-0″—1½ x 1⅝	8—½ x ¾ x 12′-0″
12′-0″—½ x ¾	1—2 x 4 x 12′-0″
Intermediate section:	1—2 x 4 x 14′-0″
12′-0″—½ x ¾	1—⅞ x 1⅝ x 12′-0″
Sill:	
12′-0″ sill	
12′-0″—⅞ x 1⅝″	
Mullion:	
14′-0″—1½ x 1⅝″	
28′-0″—½ x ¾″	
Jamb:	
14′-0″—1½ x 1⅝″	
14′-0″—½ x ¾″	
East wall:	
Head:	
12′-0″—1½ x 1⅝″	
12′-0″—½ x ¾″	
Sill:	
12′-0″—Sill	
12′-0″—½ x ¾″	2—2 x 4 x 12′-0″.
	3—½ x ¾ x 12′-0″
Mullion:	
3′-0″—1½ x 1⅝″	
6′-0″—½ x ¾″	
Jamb:	
3′-0″—1½ x 1⅝″	
3′-0″—½ x ¾″	
Windows:	
North wall: 3—7/12 C. S. glass 66″ x 46″	
East wall: 3—DSB—12″ x 46″	

Component 23.—WALKS AND DRIVES

Tile 8″ reinforced concrete	15 ft.
Pit run gravel	6 yds.
Crushed rock	7 ton

Component 24.—ROUGH GRADING

Component 25.—MISCELLANEOUS HARDWARE

Component 26.—BATH TILE

	sq. ft.
Tub wall	47.5
Window wall	32.4
Lav. wall	27.8
Door wall	32.4
	141.0

Component 30.—MISCELLANEOUS

APPENDIX D

Cutting and Order Schedule

A cutting and order schedule was also prepared in the drafting room, from the information on the drawings and the material list.

During construction, materials were ordered and delivered in advance so that no idle time could be charged for material delays. A complete list of material for any single operation insured that all necessary material for that operation would be available when work began.

The cutting and order schedule shows very clearly that waste has been reduced to almost the minimum through incorporation of the principles of modular coordination in the design of the demonstration houses.

TABLE 4.—*Cutting and order schedule*

EXTERIOR WALLS

Size 2 x 4 x —	Number required	Where	Cut from 2 x 4 x —	Waste	Use waste for—	Buy
7′−7⅝″	21	Wall 1				
	19	Wall 2				
	18	Wall 3				
	17	Wall 4				
	4	Corners				
	79		79 7′−11″	79 0′−3″	Scrap	79 7′−11″.
18′	2	Top plate, wall 1				
	1	Bottom plate, wall 1				
	2	Top plate, wall 2				
	1	Bottom plate, wall 2				
	2	Top plate, wall 3				
	1	Bottom plate, wall 3				
	2	Top plate, wall 4				
	1	Bottom plate, wall 4				
	12		12 18′	None	None	12 18′.
16′−8″	2	Top plate, wall 1				
	1	Bottom plate, wall 1				
	2	Top plate, wall 3				
	1	Bottom plate, wall 3				
	6		6 18′	61′−3″	Stock pile	6 18′.
12′	1	Top plate, wall 2				
	1	Bottom plate, wall 2				
	1	Top plate, wall 4				
	1	Top plate, wall 4				
	4		4 12′	None	None	4 12′.
12′−8″	1	Top plate, wall 2				
	1	Top plate, wall 4	2 18′	2 5′−3″	2 4′−3″	2 18′.
6′−8″	1	Door, wall 1				
	1	Door, wall 3				
	1	Door, wall 4				
	3		3 18′	3 11′−4″	3 pcs. 6′−5⅞″	3 18′.

TABLE 4.—*Cutting and order schedule*—Continued

EXTERIOR WALLS—Continued

Size 2 x 4 x —	Number required	Where	Cut from 2 x 4 x —	Waste	Use waste for—	Buy
6′—6⅜″	3	Studs, wall 3	Surplus: 3 11′—4″	3 4′—9″	3 pcs. 4′—2½″	None.
5′—6¼″	3	Studs, wall 1	1 18′	1 1′—4″	2 blocking, 0′—7½″	1 18′.
4′—3″	2	Studs, wall 4	Surplus: 2 5′—3″	2 1′	Scrap	None.
3′—8¾″	9	Headers, wall 1				
	13	Headers, wall 2			1 pc. 1′—9½″, 4 pcs. 1′	
	15	Headers, wall 3	Surplus: 1 5′—8″, 7 16′,		9½″, 1 pc. 2′ 1¾″,	5 18′, 7 16′.
	12	Headers, wall 4	5 18′.	1 1′—11″, 7 11″, 5 3′	7 pcs. 11″ stock pile.	
	49 (21 select)					
3′—1¼″	4	Studs, wall 2				
	1	Studs, wall 4	Surplus: 5 5′—8″	2′—6″	5 pcs. 1′—9½″	None.
	5					
2′—1¾″	1	Studs, wall 4	Surplus, 1 3″	1 0′—8″	Scrap	None.
1′—9½″	2	Blocking, wall 1	Surplus, 1 1′—11″	None	None	None.
	4	Blocking ,wall 2	Surplus, 5 2′—7″	5 0′—9″	Scrap	None.
	4	Blocking, wall 3	Surplus, 4 3′	4 1′—2″	Stock pile	None.
	10					
0′—10½″	1	Blocking, wall 1				
	1	Blocking, wall 4	Surplus, 2 1′—8″	2 0′—9″	Scrap	None.
0′—7¼″	2	Blocking, wall 2	Surplus, 1 1′—6″	None	None	None.
1 x 4 x 4′ 1″	1	Blocking, wall 4	1 1″ x 4″ x 6′	1 1″ x 4″ x 1′—10″	Stock pile	1 1″ x 4″ x 6′.

Summary.—79 2 x 4 x 7′ 11″ 33 2 x 4 x 18′ Frieze.—1 1 x 6 x 16′
7 2 x 4 x 16′ 1 1 x 4 x 6′ Battens.—12 1 x 6 x 8′

INTERIOR PARTITIONS

Size	Number required	Where	Cut from—	Waste	Use waste for—	Buy
2 x 4 x 16′	1	Top plate, wall 4	1 2 x 4 x 16′	None		1 2 x 4 x 16′.
2 x 4 x 5′—8⅛″	1	Top plate, wall 4	1 2 x 4 x 16′	1 2 x 4 x 10′	1 2 x 4 x 2′ 5⅛″	1 2 x 4 x 16′.
2 x 6 x 8′	2	Top and bottom plates, wall 1.	2 x 6 x 1—16′	None		2 x 6 x 1-16′.
2 x 4 x 13′—¼″	1	Top plate, wall 3	2 x 4, 1 14′	2 x 4, 1 11″	2 x 4, 1 pc. 9¼₁₆″	2 x 4, 1 14′.
2 x 4 x 8′—5⅞″	2	Top and bottom plates, wall 6.	2 x 4, 2 14′	2 x 4, 2 5′ 6″	1 pc. 2 x 4 x 5′ 4⅛″ 1 pc. 2 x 4 x 5′ 1¾₁₆″	2 x 4. 2 14.
2 x 4 x 5′—4″ 2 x 4 x 5′—2¼″	1	Bottom plate, wall 3	2 x 4, 1 14′	2 x 4, 1 3′ 5″	1 pc. 2 x 4 x 2′ 5⅛″	2 x 4, 1 14′.
2 x 4 x 3′—1⅜″	1	Bottom plate, wall 4	2 x 4 surplus, 1 5′ 6″	2 x 4, 1 2′ 4″		
2 x 4 x 5′—1¼″	1	Bottom plate, wall 4	2 x 4 surplus, 1 5′ 6″	1 4″, 2 x 4	Scrap	
2 x 4 x 2′—5⅝″	1	Bottom plate, wall 4	2 x 4 surplus, 1 3′ 5″	2 x 4, 1 5″	do	
2 x 4 x 9⅝″	1	Bottom plate, wall 4	2 x 4 surplus, 1 pc. 11″	None		
2 x 2 x 11′—11⅞″	2	Top and bottom plates, wall 5.	2 x 4, 1 12′	None		2 x 4, 1 12′.
2 x 2 x 8′	2	Top and bottom plates, wall 2.	2 x 4, 1 12′	2 x 2, 2 4′	2 pcs. 2 x 2 1′ 10⅜″	2 x 4, 1 12′.
2 x 4 x 2′ 2⅞″	1	Bottom plate, wall 4	1 2 x 4 x 2′ 4″	None		
2 x 4 x 7′ 9½″	11	Studs, wall 3				
	17	Studs, wall 4				
	6	Studs, wall 6	2 x 4, 17 16′	2 x 4, 34 2″	Scrap	2 x 4, 17 16′.
	34					
2 x 2 x 7′ 9½″	10	Studs, wall 1				
	5	Studs, wall 2				
	7	Studs, wall 5	2 x 4, 6 16′	2 x 4, 11 2″; 1 8′ 3¾″	Scrap, 2 x 4 x 2′ 7⅞″	2 x 4, 6 16′.
	22					

TABLE 4.—*Cutting and order schedule*—Continued

INTERIOR PARTITIONS—Continued

Size	Number required	Where	Cut from—	Waste	Use waste for—	Buy
2 x 4 x 2′—7⅞″	3	Door headers, wall 4	2 x 4 surplus, 1 8′—3¾″	2 x 4, 1 0′—4″	Scrap	
2 x 4 x 2′—5⅞″	1	Door header, wall 3	2 x 4, 1 10′—0″	2 x 4, 1 7′—6″	2 x 4, 2 1′—1⅜″	
2 x 4 x 1′—10′⅜′	2	Blocking, wall 6	2 x 4, 1 7′—6″	2 x 4, 1 4′—9″	1 pc. 2 x 4, —1′	
2 x 4 x 1′—0″	1	Cripple, wall 6	2 x 4 surplus, 1 4′—9″	2 x 4, 1 3′—9″	1 pc. 2 x 4, 0′—9⅛′	
2 x 4 x 0′—9½″	1	Cripple, wall 3	2 x 4 surplus, 1 3′—9″	2 x 4, 1 2′—8″	3 pcs. 2 x 4, 0′—7⅜″	
2 x 4 x 0′—9½″	3	Cripple, wall 4	2 x 4 surplus, 1 2′—8″	None		
2 x 2 x 1′—9⁹⁄₁₆″	2	Blocking, wall 1	2 x 2 surplus, 2 4′—0″	2 x 2, 2 2′—1″	1 pc. 2 x 2 x 1′—7½″ 1 pc. scrap	
2 x 2 x 1′—7½″	1	Cripple, wall 1	2 x 2 surplus, 1 2′—1″	2 x 2, 1 0′—5″	Scrap	
1 x 6 x 1′—11¾″	1	Blocking, wall 3	1 x 6, 1 3′ 0″	1 x 6, 1 0′—8″	Scrap	1 x 6, 1 3′—0″.
1 x 4 x 1′—11¾″	1	Blocking, wall 3	1 x 4, 1 12′ 0″	1 x 4, 1 9′—9″	4 pcs. 1 x 4 1′—9⁹⁄₁₆″	1 x 4, 1 12′—0″.
1 x 4 x 1′—10⅜″	2	Blocking, wall 3				
	4	Blocking, wall 2	1 x 4, 1 12′ 0″	1 x 4, 1 0′—9″	Scrap	1 x 4, 1 12′.
	6					
1 x 4 x 1′—9⁹⁄₁₆″	4	Blocking, wall 2	1 x 4 surplus, 109′—0″	1 x 4, 1 2′—5″	2 pcs. 1 x 4 0′—7⅜″	
1 x 4 x 1′—11⅛″	1	Blocking, wall 4	1 x 4 surplus, 1 2′—5″	None		
1 x 6 x 1′—11⅛″	1	Blocking, wall 4				

Summary.—1 2 x 6 x 16′ 4 2 x 4 x 14′ 2 2 x 4 x 12′ 50 2 x 4 x 7′ 11″ 1 1 x 6 x 13′ 2 1 x 4 x 12′

WALLBOARD—CEILING AND EXTERIOR WALLS

	No.	Size	Order schedule
Ceiling	14	4′ x 12′ x ½″	15 4′ x 12′ x ½″.
	2	2′ x 12′ x ½″	
	7	4′ x 10′ x ½″	8 4′ x 10′ x ½″.
	1	2′ x 10′ x ½″	
Wall No. 1	2	4′ x 12′ x ½″	3 4′ x 12′ x ½″.
	1	4′ x 10′, 11″ x ½″	
	1	4′ x 10′ x ½″	2 4′ x 10′ x ½″.
	1	4′ x 8′, 3″ x ½″	
	1	4′ x 8′ x ½″	2 4′ x 8′ x ½″.
	1	4′ x 4′ x ½″	
Wall No. 2	4	4′ x 8′ x ½″	7 4′ x 8′ x ½″.
	2	4′ x 3′, 3″ x ½″	
	1	2′ x 8′ x ½″	
Wall No. 3	1	4′ x 9′ x ½″	2 4′ x 10′ x ½″.
	1	2′, 9⅛″ x 10′ x ½″	
	1	2′ x 8′ x ½″	
	1	4′ x 4′ x ½″	
	1	2′, 9⅛″ x 3′ x ½″	
	1	1′, 3⅜″ x 4′ x ½″	
Wall No. 4	1	4′ x 10′, 2″ x ½″	1 4′ x 12′ x ½″.
	1	4′ x 10′ x ½″	3 4′ x 10′ x ½″.
	2	4′ x 4′ x ½″	
	2	4′ x 4′, 3″ x ½″	
	1	4′ x 8′ x ½″	1 4′ x 8′ x ½″.

Summary.—18 4′ x 12′ x ½″ 15 4′ x 10′ x ½″ 10 4′ x 8′ x ½″

TABLE 4.—*Cutting and order schedule*—Continued

WALLBOARD—INTERIOR PARTITIONS

	Number	Size	Order schedule
A. Wall No. 1	4	4′ x 8′ x ⅜″	4 4′ x 8′ x ⅜″.
B. Wall No. 2	4	4′ x 8′ x ⅜″	4 4′ x 8′ x ⅜″.
C. Wall No. 3	4	4′ x 8′ x ⅜″	10 4′ x 8′ x ⅜″.
	4	2′—4″ x 8′ x ⅜″	
	2	0′—6″ x 8′ x ⅜″	
D. Wall No. 4	1	4′ x 12′ x ⅜″	2 4′ x 12′ x ⅜″.
	1	4′ x 8′ x ⅜″	4 4′ x 8′ x ⅜″.
	1	4′ x 5′—4″ x ⅜″	
	1	4′ x 5′—2″ x ⅜″	
	1	4′ x 2′—6″ x ⅜″	
	1	4′ x 1′—10″ x ⅜″	
	1	4′ x 0′—10″ x ⅜″	
E. Wall No. 5	4	4′ x 12′ x ⅜″	4 4′ x 12′ x ⅜″.
F. Wall No. 6	4	4′ x 8′—5⅞″ x ⅜″	4 4′ x 10′ x ⅜″.

Summary.—6—4′ x 12′ x ⅜″ 4—4′ x 10′ x ⅜″ 22—4′ x 8′ x ⅜″

GARAGE

Size 2 x 4 x —	Number required	Where	Cut from 2 x 4 x —	Waste	Use waste for 2 x 4 x —	Buy 2 x 4 x —
16′	1	Bottom plate wall 1	1 16′	None		1 16′.
16′	2	Top plates wall 1	2 16′	None		2 16′.
16′	3	Top plates wall 3	3 16′	None		3 16′.
12′—1⅝6″	2	Top plates wall 2	2 14′	2 1′—6″	1 piece 1′—⅛″	2 14′.
12′—4″	2	Top plates wall 4	2 14′	2 1′—7″	Scrap	2 14′.
8′—8″	1	Bottom plate wall 1	1 14′	1 5′—3″	1 piece 3′—8⅜″	1 14′.
8′—4″	2	Top plates wall 1				
	3	Top and bottom plates wall 3.				
	5		5 14′	5 5′—7″	3 pieces 5′—4⅞″ 2 pieces 3′—8⅜″	5 14′.
8′—1¾″	1	Bottom plate wall 4	1 16′	1 7′—10″	1 piece each: 2′—10¼″ 2′—4⅛6″ 2′—4″ 1′—⅛″	1 16′.
7′—8¾″	1	Door header wall 2	1 7′—11″	None		1 7′—11″.
7′—5½″	2	Studs wall 2	2 7′—11″	2 0′—5″	Scrap	2 7′—11″.
6′—10¾″	2	Studs wall 4	1 14′	None		1 14′.
6′—6⅜″	13	Studs wall 1				
	4	Studs wall 2				
	13	Studs wall 3				
	6	Studs wall 4				
	36		18 14′ (waste 2 x 4)	18 0′—8″	Scrap	18 14′.
5′—4⅞″	3	Cripple wall 3	3 5′—7″	None		
3′—8¾″	3	Header wall 3	1 5′—3″			
			2 5′—7″	None		
2′—10¼″	1	Header wall 3	1 7′—10″	1 4′—11″	1 piece 2′—4⅛6″	
2′—4⅛6″	1	Bottom plate wall 2	1 4′—11″	1 2′—5″	1 piece 2′—4″	
2′—4″	1	Bottom plate wall 2	1 2′—5″	None		
1′—⅛″	1	Bottom plate wall 4	1 1′—7″	1 0′—6″	Scrap	

Summary.—7 2 x 4 x 16′ 29 2 x 4 x 14′ 3 2 x 4 x 7′—11″

TABLE 4.—*Cutting and order schedule*—Continued

GARAGE JOISTS

Size	Number required	Where	Cut from—	Waste	Use waste for—	Buy
2 x 8 x 13′—4″	12	Garage joists	2 x 8 x 16′	2′—8″	3 2 x 8 x 1′—10⅝″ 10 2 x 8 x 1′—9″	12 2 x 8 x 16′.
2 x 8 x 12′	14	Breezeway joists	2 x 8 x 16′	None		14 2 x 8 x 12′.
2 x 8 x 8′	2	Beam	2 x 8 x 8′	None		2 2 x 8 x 8′.
2 x 8 x 6′	1	Outlooker	2 x 8 x 6′	None		1 2 x 8 x 6′.
4 x 4 x 10′	1	Post	4 x 4 x 12′	None		1 4 x 4 x 10′.
2 x 8 x 3′—9″	5	Outlookers	1 2 x 8 x 16′ 1 2 x 8 x 12′	1′—6″ x 2′—6″		1 2 x 8 x 16′. 1 2 x 8 x 12′.
2 x 8 x 1′—9″		Blocking	Scrap			

U. S. GOVERNMENT PRINTING OFFICE: 1954 O — 296040

Housing
Research